

AGRICULTURE OF TOMORROW

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AND
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FOREWORD.

It is a rather strange moment in which to write a book. England has declared war on Germany and nobody knows how long it will last. It is still stranger perhaps, that the book I am about to write originates from the German spirit, the true German spirit which has always been appreciated in the cultivated world.

We are in the midst of destruction; the powers of war are relentless; they are destroying the life of man, of whole populations; they are destroying masterpieces of art and cultural life. In such a moment it is imperative to acknowledge the immense need of constructive and regenerative powers.

I want to write therefore about the regeneration of agriculture, which is the basis of the physical existence of men. Without proper food mediating life-forces to the human organism, human beings cannot grow strong and healthy, nor become able to develop the clear minds and moral strength we so urgently need.

The task of agriculture is overwhelming. The farmer and gardener help to build up the physical body of mankind. They work with the most valuable material we can think of—Mother Earth. Out of the earth the plant-life grows. The plants nourish the animals, and plants and animals contribute to our life.

This book will contain an account of scientific work carried out since 1920. Until the year 1936 I worked in the Biological Institute of the Goetheanum in Germany (Stuttgart), and since then in the Biological Institute at Bray, near Maidenhead.*

In 1924 Rudolf Steiner, well known as scientist and founder of the Anthroposophical Movement, entrusted me personally with the task of making all the necessary scientific investigations in connection with his Agricultural Course. Since 1924 I have studied all his suggestions for regenerating Agriculture. Many farmers and gardeners all over the world practise his methods; and for this there exist various associations bearing various names. I do not belong to any of them and have in mind to speak only of my own scientific investigations, holding myself responsible for them.

It is to be regretted that the original lecture course of Rudolf Steiner is not yet published and is only entrusted to a relatively small group of farmers, gardeners and other personalities in the form of a private manuscript. I restrict myself to the shorthand notes I was entitled to make during this course, held at Koberwitz (estate of Count Kayserlingk) and the innumerable personal suggestions I received from Rudolf Steiner. I am convinced that this will be sufficient to make the importance of the subject quite clear to every earnest reader and to enable him to benefit by this new agricultural method. Nothing will be withheld; this is no time for secrecy. Rudolf Steiner meant his suggestions for the whole world, not for a small group of privileged farmers. Only a real understanding of the wonderful organism "Agriculture" will make it possible to grow healthy food.

London, 28th September, 1939.

L. KOLISKO.

* Since 1940 the work has been continued in Rudge Cottage, Edge, nr. Stroud, Glos.

NOTE.

It was originally intended that this book should be written in two parts, by Dr. Kolisko and myself working in collaboration. He had collected his material during many years. In the early morning hours of November 29th, 1939, he called me and said he was ready to begin. He was full of enthusiasm and energy for the task. A few hours later he suddenly passed away.

Yes, we were both ready. It is my duty to write the book now with the help of his notes and remembering our talks upon all the various aspects of the subject. But it will still be our book, the fruit of our common studies and the work of many years together. May it help to solve the urgent problems of our present time.

L. KOLISKO.

Christmas, 1939.

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PREFACE.

AGRICULTURE OF TO-MORROW.

War found Britain facing the necessity of a new agricultural policy. More food is wanted ; there is a need for such measures as intensified food-production, greater crops, the use of every acre of waste land, and the transformation of pastures into cultivated land.

These measures are already in progress, and they will no doubt be carried out with the utmost energy and efficacy throughout the British Empire.

But what about to-morrow ? What is the agricultural situation in the world to-day ? The war coincides with the greatest crisis in the world's agriculture which has ever threatened mankind.

This threatening position has been disclosed by a series of publications brought out on the eve of hostilities. We should not allow these revelations to be forgotten in the present critical state of justified measures of war. From a large number of such testimonies I select only three most significant voices.

In recent publications by G. V. Jacks and R. O. Whyte, **The Rape of the Earth** and **A World Survey of Soil Erosion** (Faber & Faber Ltd., London 1939) the following statement is made : " Misapplied science has brought to the world's richest virgin lands a desolation compared with which the ravages of all the wars in history are negligible. New outlooks, new aims and new knowledge will be required before the earth is again fit to rear after long travail another civilisation."

With regard to the situation in the United States, the above-mentioned authors continue: " More striking however, is the statement quoted by Raymond Irving, that at the present rate of soil and water depletion, in fifty years the fertile soil of America will be a fourth of what was present originally, and that in a hundred years at the same rate of depletion the American Continent could turn into the Sahara of the Western Hemisphere."

That such a statement is by no means exaggerated is proved by the fact that the U.S.A. Department of Agriculture issued in 1938 its year book in an entirely different form. It bears the unusual title, **Soils and Men**, and the foreword is an S.O.S. made by the Secretary of Agriculture, Mr. Henry A. Wallace. To avoid the threatening danger of soil erosion and soil disease, he pleads for a change in the methods hitherto employed.

Last but not least, I want to draw attention to the appeal of C. Alma Baker, C.B.E. the well-known veteran expert on rubber planting. Of this memorandum, published in June 1938, 50,000 copies have been distributed to members of parliaments, ministries, agricultural and health authorities, hospitals, etc., and it demonstrates clearly the necessity for entirely new measures for soil preservation and regeneration. " The two systems of agriculture that gave me hope of improving the health of soil, plant, animal and man, came before the public a few years before, in the methods of 'Dynamic Agriculture' and the 'Indore' Process. . . . the theory and practice of the principles of the above two systems of

agriculture have impelled me to write this memorandum. I therefore have appealed to all the governments to investigate the influence of manurial substances and systems upon the soil and the nutritional value of its products." So indeed if war compels us to adopt a new agricultural policy, we should make use of the results which have been achieved during the last decades. Let us avoid previous mistakes and provide not only for war but at the same time for the future of mankind.

The recent investigations of both European and American scientists clearly point to the fact that plant growth, crops and animal productivity depend on cosmological influences and vary in well defined cycles. Elsworth Huntington has shown the influence of the sunspot period of eleven years on the weather and on the growth of trees. An increasingly large number of modern investigators have verified the connection of the sunspots with temperature, atmospheric pressure, rainfalls, magnetic streams, etc. And again others have demonstrated how these affect harvests, output, and prices.

Already various American and Russian economists are beginning to calculate the economic cycles which result from astronomical and meteorological cyclic influences. It appears as though economy will become part of a new kind of cosmological science.

Whether the Moon influences plant growth may still be a matter of controversy. But is it not a recognised fact that the tides are influenced by the moon, and that certain diseases such as epileptic fits, somnambulism and sleep walking occur more frequently at a certain phase of the moon? Why should such influences not be of universal character? Is not all plant life more or less rhythmic or periodical? And if so, will not our negligence of these connections have a detrimental effect?

Another vast field of knowledge has been opened up through recent investigations into the true nature of the soil. Having gone through the whole literature on this subject, I am astonished to find quite a miraculous agreement among the various scientists on one essential point, namely, that the soil is by no means a mere aggregate of chemical substances, as it was considered to be only a few years ago; it is a living organism.

"The soil is not a dead system but is teeming with life" says S. A. Waksman in his authoritative book on Humus (1938). "Organic matter thus supplied the life of the soil in the strictest sense" (W. A. Albrecht in the U.S.A. "Agricultural Year Book"). Or, "It may be said that there is no soil without organic matter" (Byers, Kellog, Anderson, in "Formation of the Soil.")

The problems of nutrition, of pure food, and of animal diseases, and also the health of human beings, are inseparably connected with the agricultural problem.

Another scientific epoch in agriculture has already begun. It is to be hoped that new ventures necessitated by the war will be the prelude to large scale scientific use and protection of the soil.

EUGEN KOLISKO.

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INTRODUCTION.

Now-a-days every farmer and gardener should once again learn something about cosmic influences. If we go back in history, we find that there was a real knowledge about the relationship between cosmos and earth. In this book we want to deal primarily with agriculture, so we must limit ourselves to mentioning only a few of these interesting facts. We need go no further back than the time of **Pliny** (23 A.D.). In his "History of Nature" we read about the influence of the moon on the growth of plants. Many instructions are given about the gathering of plants, and about pruning or cutting trees, according to the phases of the moon. If it was desirable that the plants should continue to grow, then cutting and pruning should be carried out during the full moon. If, on the contrary, it was not desirable that the plants should go on growing, these operations should be carried out during the new moon.

If you wanted to sell fruits, then it was better to gather them during full moon because they would be full of juice and good to look at. If you wanted to preserve the fruits for some time, then it was better to harvest them during the new moon, because they would not rot and would dry more easily. Harvesting of all kinds of vegetables had therefore to be done during the new moon, also the collecting of fallen leaves.

Manure had to be stirred during the waning moon, and it was best to manure the fields at new moon or half moon to avoid the growth of weeds.

During full moon it was good to cover the roots of the trees.

In damp places it was better to sow during new moon and the following 4 days. From new moon until half moon, the moon was supposed to encourage fruitfulness, in the second period, half moon to full moon, the moon was supposed to give warmth.

In the 18th book of his History of Nature Pliny says, that in bygone times people lived crudely and without any "science." "But, we will see, that their sense to observe such things was not less keen than our present calculations. They were afraid of three periods of the year where their fruits were concerned, and therefore they created three holidays and festivals: the rust-feast, the feast of the blossoms, and the wine-feast."

"The rust-feast was created by Numa (about 703 B.C.). Now we have it on the 7th day of the Kalends of May (25th April) because it is about that time that the rust may attack plants. According to Varro, this is the time, when the sun stands in the 10th degree of Taurus. But the real reason is, that 21 days after the Spring equinox, the dog-star, a very violent star, descends. And before this, the small dog-star has to descend."

"The feast of the blossoms has been fixed for the fourth day of the Kalends of the same month (237 B.C.) according to the prophecies of the Sibyl, so that every-

thing may blossom successfully. According to Varro, on this day the sun is in the 14th degree of Taurus. If there happens to be a full moon during these few days, all the fruits and everything that blossoms will be damaged."

"The first feast of the wine (during which it was customary to make offerings of the new wine to Jupiter) was fixed for the 23rd of April; testing the new wine has nothing to do with the fruits and also nothing to do with the wine plants and oil trees, because the fructification of those begins when the Pleiades are rising, that is the 10th of May. That is another date covering about four days, during which period they do not like to get dew, because they are afraid of the descending cold constellation of Arcturus, and in no way should there be the interference of the full moon. These are the times when sterility may be caused through the heavens." . . .

Pliny also states, that during the Summer the new moons are harmless, and during the Winter the full moons, with the exception of two days; further that one has only to be afraid of the very short summer nights, but not of the days.

So we find that during the time of Pliny there was quite a detailed "science" of the effects of certain constellations and of the influence of the different phases of the moon on plant growth. And Pliny looks back to past centuries where people had "no science" as yet, but nevertheless knew about the influence of the cosmos on earthly processes.

But not only plant growth was influenced by the moon. Pliny also speaks about the influence of the moon upon **animals**.

He tells us that the **ants** rest during the new moon and are very busy during full moon, even at night. "Oysters and other similar creatures grow during full moon and slacken growth during new moon."

"If it is desirable to castrate bulls or other animals, it should be done during the waning moon."

Even the human being is subject to certain phenomena which are connected with the moon. Female menstruation has always been held to be related to the moon. We even find conception and birth similarly related. We count the period of pregnancy by lunar periods. It was thought that the waxing moon facilitated the process of birth, whereas the waning moon made it more difficult.

Pliny also writes about the influence of the moon on weather conditions. If it rises very bright and clear, it means good weather; if it rises with a red glow, it means a storm; if it rises darkened, it means rain.

Or let us read **Virgil**. In his poem about **Agriculture** we get a marvellous description of the cultivation of the land, of fruit trees, the raising of cattle and each single work is closely connected with occurrences in the heavens. Sun and Moon, Saturn, Jupiter, Mars, Venus and Mercury have to be observed by the husbandman, as well as all the constellations. Certain seeds have to be sown when the "glittering Taurus opens the year with his golden horns." If the farmer

wants to grow wheat, then he must wait until the Pleiades hide themselves in the morning (*i.e.* between 20th October and 8th November) ; if he wants to grow beans or lentils, he must wait for the descent of Boötes, etc.

Then came the epoch, when modern natural science developed, and nobody believed any longer that the stars, far away from the earth, could have any influence upon earthly affairs.

It is interesting to read in this connection the publications of the famous German scientists Professor Schleiden and Professor Fechner. Fechner was still convinced of the influence of the moon on weather conditions. He calculated from careful statistics that there is more rain during full moon than during new moon periods. He found the proportion as 107 : 100. Professor Schleiden was very annoyed by the views of his colleague and he published a work in which he started by quoting Pliny, as I have done. He then passed to the Middle Ages, where people thought remedies would be effective if they were applied according to the phases of the moon. Finally he dealt with his colleague Fechner. Fechner, a young student, had written a humorous pamphlet : Does the moon contain Iodine ? In this pamphlet he ridiculed the idea that certain remedies, immediately after they were discovered, had great powers attributed to them. Sometimes they came to be regarded as universal remedies, able to cure nearly every kind of disease. But slowly they became antiquated and, by inference, weaker and weaker. Their radius of action became smaller and smaller, and very often they finished up like old, childish people, thrust into a corner. Schleiden points out that this is also the fate of the moon. The good man has grown old and weak, and only a few people, who have grown old and weak with him, cherish his memory like that of an old family doctor. "What can he do ?" asks Professor Schleiden. "An old, burnt out globe of dead matter slowly turns round the earth. Its average distance is about 52,000 miles, its whole orbit only about 326,000 miles ; and to complete its circuit this lazy body takes 27 days and nearly 8 hours, whereas our earth covers 14,000 miles in a single hour. Its whole surface accounts to 690,330 square miles, about as much in area as the land in the southern hemisphere of the earth, or about 1/10th of its water area. Its plane makes an angle of only 5 degrees with the earth. From time to time it turns its back to the sun and since it gets its light from the sun, it is then completely dark."

Then Schleiden complains that the moon is also a weakling as far as "light" is concerned. It reflects no more light from the sun, than a small white cloud, and disappears completely in day time.

The warmth which may come from the moon is so insignificant therefore, that for a long time one did not even believe in its existence. It was necessary to construct a very fine apparatus (Melloni) to be able to measure it.

Even its force of gravitation is very weak. And from this weakling people dare to expect considerable effects on the earth !

Schleiden does not even believe that the moon has any influence upon the tides.

It is really extremely interesting to study this controversy in the 18th century. No virtue whatsoever was left to the moon.

Schleiden asserts that "in the 16th and 17th centuries science has abolished astrological superstitions. For natural science the moon has become merely one of the heavenly bodies. As for its activities we can only admit forces like gravitation, light and heat, and we should not dream about further things of which we know nothing. We must confess, like astronomers and true scientists of the last hundred years, that we are fully entitled to push the old, weak and powerless moon from his throne of earthly power.—"

That is the period in which it was not "scientific" to speak of an influence of the moon, or of any other heavenly bodies, on the earth. They were much too far away.

Today it begins to be different again. We are beginning to talk about "cosmic waves," radiations as direct or indirect emanations of the stars. This is perfectly scientific. These emanations come from every part of the cosmos; they penetrate everything; they influence our life as well as producing physical phenomena. The moon is coming into its own again.

We know that lunar radiations are responsible for interference with transmission from wireless stations. There are maxima and minima of intensity in the reception of electro-magnetic waves which correspond to the phases of the moon.

There is a very interesting book by an engineer George **Lakhovsky**.* He is a Russian, who later became French. The book was originally written in French and later translated into German, also Italian and Spanish, and very recently, into English. The German translation was published in Munich 1932. In the eighth chapter of this book, Lakhovsky deals with the influence of sunspots and cosmic radiations on life and health. He points out, that the sun not only sends us light and warmth and emanates ultra-violet rays, but also gives off electric and magnetic waves, especially during the eruptive periods of the protuberances, or sunspots. Under the guidance of Deslanders, the director of the Observatory of Meudon, astro-physicists have made investigations into the correlations of the intensity of sunspots with certain accompanying phenomena. They have observed that inundations, terrestrial cataclysms, tidal waves, and especially earthquakes seem to be associated with sunspots.

We see that occurrences on the sun are reflected on earth. And if we ask why, then the scientist answers: there is interference with the normal field of cosmic waves by solar waves emanating from the sunspots.

Lakhovsky also mentions the connection between the sun and meteorological phenomena. Already in 1651 an Italian scientist Riccioli, mentioned this fact; then in 1801 Herschel* confirmed the observation, and in 1887 the astrophysicist

* George Lakhovsky: *Das Geheimnis des Lebens*, C. H. Beck'sche Verlagsbuchhandlung, München, 1932.

* On the 14th of March, 1781, Herschel discovered in the constellation of "Gemini" the planet **Uranus**. He proposed for the new planet the name "Georgius Sidus" because King George III of England supported his astronomical observations.

Baxenbell was able to show how the average temperature on earth was connected with the number of sunspots.

It is interesting to know that the periodicity of the sun, about $11\frac{1}{2}$ years, is again influenced by other cosmic waves so that we get an interfering period of about 33 to 35 years. This period has been found out by Brückner through the observation of rainfalls. Observations made in Madras, Washington and 100 other stations have shown that, outside the tropics, solar radiation causes two alternating periods of rain and drought in the course of about 35 years.

A similar periodicity has been observed in the drift of icebergs and the variation of level in lakes.

Sir William Herschel also pointed out that a scarcity of vegetation appeared whenever the sun was seen to be free from spots. In 1901 Moreux observed, that wheat production in France and in the whole world followed roughly the variations in intensity of the sun's radiation.

Dr. W. J. Stein, editor of the periodical *The Present Age*, published in a special number (June-July, 1937), an extremely interesting and important work on "The Earth as a basis for World Economy." Chapter VII deals with "the Solar and Planetary Influences on Weather and Climate as the Foundation of Harvest and Prices. . . ."

"It has been discovered that the sunspot maxima and minima are related to the cyclones and the quantity of rainfall, not, however, unconditionally, but according to the geographical position of the point of observation. As regards the summer monsoons in India, it has been ascertained that during the maxima years of sunspots the rainfall is higher than in the minimum years. The winter rainfall in northern India follows the opposite course." (A. Hill, "Variation of Rainfall in Northern India," *Indian Met. Memoirs*, vol. I No. 6,878.)

"The fact of the connection being thus established, we must note that the character of the relationship depends upon geographical and seasonal modifications. For instance it has been found that in the central parts of North America and along the coast of Labrador a temperature prevails in years of extensive sunspots, which is lower by several degrees, whilst on the other side of the Atlantic from the Bay of Biscay to Spitzbergen exactly the opposite happens. The minimum epochs of the sunspots produce cold years and the maxima epochs warm ones*. It is most instructive to see that one and the same cosmic event can produce such different effects in various parts of the world. This would seem to be the rule.

North Japan has a good rice crop if August is warm. A warm August in Japan may, however, depend on the rising of the air-pressure in the south east coast of Canada in April†.

* J. Mecking, *Annalen der Hydrographie* 1918, p. 1.

F. Baur, *Mitteilungen der Wetter und Sonnenwarte St. Blasien*, Heft 2, 1922.

† T. Okada, ref. p. 652, Hans Suering, *Lehrbuch der Meteorologie*.

There is a strange interdependence of conditions at various points on the earth. We are only beginning to reach an understanding of this fact. The greater the difference between the temperature of the Atlantic Ocean current on its surface and its temperature at a depth of 200 metres, the better will be the harvest in Norway: even the German wheat and rye crops are influenced by this factor||.

A small percentage of ice around Iceland in the Spring corresponds to favourable conditions for corn crops in Western Europe and North Germany†.

We see that sunspots or changes in the circulation of the oceans have, like other cosmic events, very different effects on different parts of the earth. If we could understand them in their totality, they would reveal themselves as organic dependencies in a living being.

This variation of the sunspots is by no means a primary phenomenon. A number of scientists have shown that the phenomena of sunspots are related to the planets.

The investigations carried out by the scientists Kr. Birkeland‡, E. W. Brown*, A. Schuster**, Franz, J. Goeschel***, Elsworth Huntingdon****, Vladimir B. Schostakowitsch***** and Inigo Jones^o have made it clear, that the period of sunspots is no more than a combination of planetary periods. The planets therefore are working behind all the phenomena which are ascribed to the sunspots. Partly directly, partly by way of the sun, the planets modify the course of events. As the sun radiates into space against gravity and the planetary forces come into operation wherever such radiations against gravity take place, so the radiations of the sun must needs succumb to the influence of the planets. With regard to direct planetary influences, only Venus has been so far observed. Henry Ludwell Moore§, indicates the connection between the rhythm of the sunspots and the rhythms of Venus. Every eight years the rays of Venus are particularly bright.

|| Alexander Supan and Erich Obst: *Grundzüge der physischen Erdkunde* vol. 1, p. 332, Berlin, Leipzig 1927.

† Mainarvlus: *Schwankungen der nordatlantischen Zirkulation und ihre Folgen*. *Annalen der Hydrographie* 1904, p. 353.

‡ Kr. Birkeland, "Recherches sur les taches du Soleil et leur origine," *Skriften udgivne af Videnskabsels Kabet* 1, Christiania 1879.

* E. W. Brown, "A possible explanation of the Sunspot Period," *Monthly Notices, Royal Astron. Society*, vol. 1x No. 10, 1900 pp. 599-606.

** A. Schuster, "The influence of the planets on the formation of Sunspots," *Proceedings Royal Society London*, vol. lxxxv, 1911, pp. 309-323, deals with Mercury, Venus, Mars, Jupiter, Saturn.

*** Franz J. Goeschel, *Planetare Einflüsse auf die Sonne*, Salzburg 1912.

**** Elsworth Huntingdon, *Earth and Sun; Weather and Sunspots*, Newhaven 1923, p. 212.

***** Vladimir B. Schostakowitsch *Sonnenflecken und Planetenstand Meteorologische Zeitschrift*, Berlin 1928, vol. x.

^o Inigo Jones in *Nature*, July 31, 1932, dealing with Jupiter, Saturn, Uranus, Neptune.

§ Henry Ludwell Moore, *Economic Cycles, their law and causes*, 1914. *Generating Economic Cycles*, New York 1923.

She does not, as one might expect, show the whole disc, but only a sickle with a faintly luminous shadow. She is however especially close to the earth in this constellation. Five weeks before her lower conjunction Venus can be seen thus and she shines with exceptional brilliance if she is at the same time in close proximity to the earth. The diameter of Venus is then 40 inches and the size of the luminous part 10 inches, so that less than a quarter is shining. In this position she sends more light to the earth owing to its nearer proximity, than when radiating with her full disc*.

All these cosmic and meteorological rhythms have at any rate been studied from an economical aspect, and extensive literature on the subject is available. The already mentioned observations of Sir William Herschel were made after he had read the fundamental work of Adam Smith and his observations on prices. It struck Herschel, that these periods, taken purely economically coincided with those of the sunspots. As the realization of the relationship first came to an astronomer and not to an economist, this fundamental discovery was ignored. The astronomers regarded Herschel's excursions into the economic field with disfavour, considering them to be quite out of place. The unfortunate position between the scientific disciplines, as in so many cases, once again stood in the path of progress. One cannot help smiling when one reads the polemics against Herschel in the Berlin Astronomical Year book, and than his cool reply a year later (1806-1807). There is a decided advantage in settling polemic differences in a yearly periodical. It leaves time to develop sufficient phlegm!

The following reflections would seem to contradict Herschel, but Herman Fritz has refuted these statements and recent research corroborates Herschel on all points†.

Henry Arctowsky's‡ investigations are of special importance because the fact dawned upon him that the temperature system of the earth is an organic unit, in which each part is connected with every other part. Sir William Beveridge** and Westergaard have investigated the problem economically from many different aspects.

Eduard Brückner†† shows the influence of the fluctuations in the climate on the crops and corn prices. His work on this subject provides the best introduction to meteorological problems and it is satisfactory to observe the versatility of his descriptions.

That the influence of the sunspots is indeed a remarkable one is shown by the research work of the zoologists.‡‡

* George Chambers, a Handbook of descriptive and practical Astronomy, Oxford, 1889.

† Hermann Fritz, Die Beziehungen der Sonnenflecken zu den magnetischen und meteorologischen Erscheinungen der Erde, Haarlem 1878. Naturkundelige Verhandelingen van de Hollandische Maatschappij der Wetenschappen, vol. iii, Derde Versameling.

‡ Henry Arctowsky, Studies on Climate and Crops, New York 1910-12.

** Sir William Beveridge, "Weather and Harvest Cycles," Journal of the Royal Economic Society, June 1920, March 1920 and December 1921.

†† Eduard Brückner, Klimaschwankungen, Wien, 1890.

‡‡ H. Simroth, "Der Einfluss der letzten Sonnenfleckenperiode auf die Tierwelt," Kosmos 9, 1908. A. W. Anthony, "Periodical emigrations of Mammals," Journ. Mammal, vol. iv, p. 60. R. E. de Lary, Arrival of Birds in Relation to Sunspots, 1923. C. Elton, "Periodical Fluctuations in the number of animals," British Journal of Experimental Biology, vol. ii, No. 1, October 1924, Edinburgh University.

Vladimir P. Schostakowitsch in his excellent book on periodical fluctuations in the phenomena of nature (1931) with references to further literature, has dealt with their influences on economic life in a most thorough fashion."

And again I return to Lakhovsky's book chapter VIII in which he states, that it has been officially confirmed that the great famines in India occur every 11th year; that means again a sunspot rhythm.

A comparison between the statistics of the observatory Meudon with the statistics of wine production in Bourgogne and Beaujolais showed that the remarkably good wine years corresponded with the years of sunspot activity. With regard to wine he has noted that the remarkable years of 1847 and 1915 corresponded exactly with the maximum activity of the sunspots, according to the documentation established by the Chambers of Commerce of Bourdeaux and Burgundy.

For the red wines of Bourdeaux the results are the following:—

Maximum of Sunspots	1848	remarkable wine	1847 and 1848
" " "	1858	" "	1857 " 1858
" " "	1869	" "	1869 " 1870
Period 1880-1889		Phylloxera	
Maximum of Sunspots	1893	fairly good years of	1890-1899
" " "	1906	good years of	1906-1907

Mention must also be made of the famous wine of 1811 as the " wine of the comet" whose excellent quality may be attributed to this comet's radiation.

Lakhovsky has also the conviction that the interference caused through sunspots, may produce if not disease, at least fatigue and slight disturbances in the state of health of people.

As to the moon, Lakhovsky reports on some interesting experiments he has carried out. It is possible to sterilize water and other liquids through direct contact with metallic conductors. He found that the sterilizing effect of the metal was different according to the phases of the moon. The metal used was silver. In April 1929 (full moon) 26 hours were necessary to sterilize the water; the following month, again during full moon, 40 hours; on the 18th June, the experiments being carried out 4 days before the full moon (full moon on the 22nd June) the contact with silver even produced the opposite effect; instead of sterilizing the water, the bacterial growth was enhanced. During the waning moon the water was sterilized in from 6 to 7 hours. These experiments have been carried out in two different laboratories in the " Salpêtrière " and " l'Institut Pasteur."

These experiments are extremely interesting. Lakhovsky uses as contact metal " Silver." That means he uses a metal which is especially apt to be influenced through the moon. In the year 1929 when Lakhovsky made these experiments I published the book " Das Silber und der Mond " (Silver and the Moon), experiments carried out in the Biological Institute at the Goetheanum in Stuttgart, Germany.

In this publication I tried to show by means of experiments made with filter paper, that a solution of silver salt produces different effects if used during full moon or new moon.

Slowly the ring will be closed. Ancient wisdom of centuries long gone by and modern natural science will be able to meet. There is one "special" metal, "belonging" to each planet. It is affected, if the planet undergoes certain changes. In old traditions, iron is the metal of Mars and gold the metal of the Sun and lead the metal of Saturn, etc., and this can now be proved to be true with the help of scientific experiments*. This matter will be dealt with in the book "The Seven Planets and the Seven Metals," an attempt to unite Astronomy, Chemistry and Physiology. But it is necessary to mention here, that the moon not only influences plant growth, certain processes in the animal kingdom, and also sometimes the human being, it is also related to the metal silver.

Moon and water are a unity. Wherever there is water, there is also the activity of the moon. And again we need to take the word water in a wider sense. We do not mean only rainwater, or distilled water, we mean it as a representative of the liquid state. The moon rhythm is embodied in the water itself. The tides are not there because the moon always attracts water. Once the moon was united with the earth; that is an acknowledged fact. At that time our solid earth had not yet been formed. We must picture everything as being in a more or less liquid condition. After the exit of the moon, the earth became solid, but all the remaining "water" still behaves like the moon. The moon itself has solidified, but it moves according to the same rhythms as the liquids move on earth.

In the same year 1929* we also published a series of experiments, carried out during some years, connected with the influence of the moon on plant growth. These experiments have been carried out incessantly, therefore we have to-day extensive material at our disposal.

Professor d'Arsonval writes in his preface to Lakhovsky's book "The Secret of Life": "... that space is full of forces which are unknown to us and that living beings emit radiations or effluvia of which we are not aware, but whose significance has attracted the attention of certain observers, are facts that I have long since accepted. Anything is possible. But one must not accept anything except that which can be proved experimentally. The ideas of an insane person differ from the conception of a genius mainly because experiment invalidates the former and confirms the latter."

Well—it can be proved experimentally that the moon influences the growth of plants. This will be shown in the following chapter.

* L. Kolisko: *Sternenwirken in Erdenstoffen*.

- I. 1927 (English translation) *Workings of the Stars in earthly substances*.
- II. The Solar Eclipse of June, 1927.
- III. 1929 Silver and the Moon.
- IV. 1932, Jupiter and Tin.
- V. 1936, The total solar eclipse of June, 1936.

Chapter II.

MOON AND PLANT—GROWTH.

A detailed publication which I can only summarise here, on plant growth, appeared in English in 1936*. Experiments have been carried out for 15 years, partly in the laboratory, partly in the open.

Experiments carried out in the laboratory :

Carefully selected grains of wheat (8 different species) oats, and barley, were inserted in glass dishes containing garden soil. The soil used for these experiments was carefully prepared and did not contain any artificial manure. After a fortnight the plants were measured. Normally two leaves develop so the measurement was taken of the first leaf, the second leaf, the internode and the roots. Provided the grains had been carefully selected, there were no great differences between the 30 plants growing in each glass dish. For each species of grain two glass dishes were used and each contained 30 grains. The first experiment started at full moon and ended at new moon ; the second experiment started at the waning quarter and ended at the waxing quarter ; the third experiment started at new moon and ended at full moon ; the fourth experiment started at the waxing quarter and ended at the waning quarter ; thus it continued for many years. Each week one experiment ended, and the next began. The result obtained is highly interesting. I have never been able to publish all the experiments which were carried out in this connection and this time I have again to limit myself, and can only mention briefly what has been done.

At the end of a year a graph could be drawn showing the average length of the first leaf, the second leaf, the internode and the roots of the wheat grown during the various phases of the moon. Such a graph shows in the first part increasing, and in the second part decreasing growth. The maximum growth is always reached during the **waxing** moon-period, from new moon to full moon. That seems to be a law. It repeats itself year after year. The month may vary, sometimes the maximum of the year is reached at the end of June, sometimes in July or even the beginning of August. Fig. 1 shows an example of this type of graph.

* L. Kolisko : *The Moon and the Growth of Plants*, 1936.

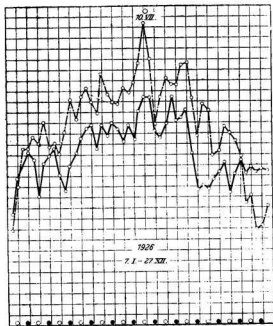


FIG. 1.—Graph representing the average growth of wheat during the various phases of the moon in 1926.

Whoever is interested in this subject finds a detailed account in the book mentioned before.

Beyond any doubt these experiments prove that the moon influences plant growth.

Experiments carried out every day :

For some years grains of wheat were inserted in glass dishes (as described before) every day ; that meant 365 experiments a year. Each day one experiment had to be measured, and a new one started.

One series of experiments was carried out in the laboratory in a room with windows facing south ; another series in a room with windows facing west ; one series of experiments in a glass house.

These experiments showed very clearly which were the most favourable days during the year. The best results, the biggest plants, we found nearly always two days before full moon, sometimes three or four days before full moon.

Experiments carried out in the open :

These experiments started in 1926 with maize. The seeds were sown 2 days before full moon, according to a suggestion of Rudolf Steiner ; and the experiment was repeated a fortnight later, 2 days before new moon. The seeds sown 2 days before full moon sprouted very quickly, and strong, healthy plants developed.

The seeds sown 2 days before new moon needed longer to sprout and developed very poorly.

To ascertain this effect, similar experiments were carried out, year after year, with a great variety of plants, and we always got the same result.

One objection could be raised : if the first experiment starts two days before full moon, and the second two days before new moon, the second experiment will always be a fortnight younger. **Is not the difference in growth only due to the difference in time ?** This objection is easy to overrule. We must say that the difference is much greater than can be accounted for by a fortnight's difference. Furthermore we always get many more flowers ; or later on, a much bigger crop from all the vegetables sown two days before full moon.

But we can also make an experiment which excludes any mistake entirely. We plant at three successive phases of the moon. The first experiment starts 2 days before the full moon ; the second a fortnight later (2 days before new moon) ; and the third experiment again a fortnight later (2 days before the next full moon). If the difference in growth is only due to the difference in time, then the third experiment—being the youngest—should have the smallest plants ; and the first one the largest plants. But this never happens. The first and the third experiments are much better than the second between them. Fig. 2 demonstrates one such experiment with carrots.

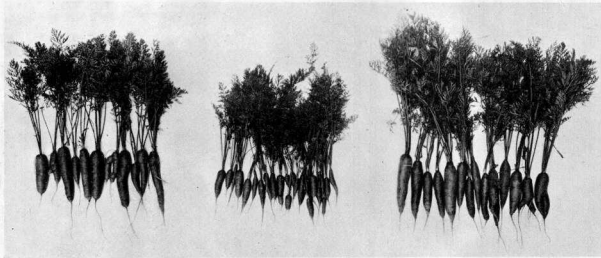


FIG. 2.—Carrots grown two days before full moon, two days before new moon and again, a fortnight later, two days before full moon.

Experiments with Tomatoes :

Tomato seeds respond strongly to the moon. We experimented for many years, and always with the same rather startling effect. Every year four series (spread over two months) were sown in the frame, two days before full moon, and two days before new moon respectively. They were pricked out and transplanted into the open. In the frame it was observed, that those seedlings which had been sown two days before full moon appeared much more vigorously and formed complete rows ; while those sown two days before new moon were much weaker, and some did not germinate at all. The result became even more evident, when four series were sown over a period of two months. The second full moon was a fortnight younger than the first new moon and nevertheless the plants were finer and stronger. The pricking out and transplanting, if possible, was done in the corresponding phases of the moon.

In the open the difference between the new moon and the full moon tomatoes was easily seen ; the latter showed a deeper green foliage, and gave better yields by at least 60 per cent.

Very often we noticed that, in autump, the new moon plants had already yellow foliage, while the full moon series still showed a fresh, vivid green.

From a qualitative standpoint the full moon tomatoes had more juicy fruits.

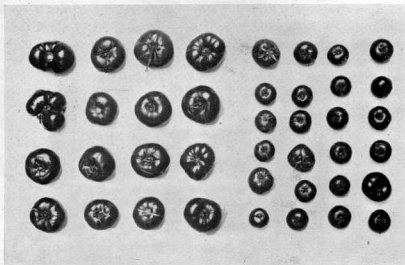


FIG. 3.—*First and second series.*

Report on Tomato Experiments carried out 1934 :

We had 5 series of experiments sown in the frame :—

first series	two days before	full moon			
second	„ „ „ „	new moon			
third	„ „ „ „	full moon (next month)			
fourth	„ „ „ „	new moon	„ „		
fifth	„ „ „ „	full moon again	a month later.		

The fifth series was therefore the youngest. Fig. 3 and 4 show the average result.

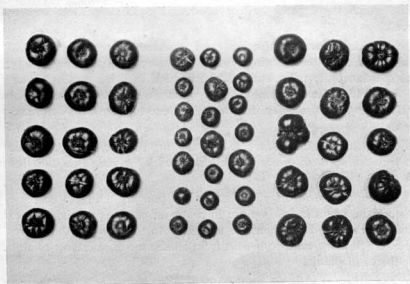


FIG. 4.—Third, fourth, fifth series.

The three full moon series were very prominent compared with the new moon series. The yield of each series was carefully noted and the proportional value worked out as follows :—

Series :	I	II	III	IV	V
	2.9	1.4	2.6	1.2	2.5

It is interesting to observe how the quantities among the full moon series decrease from 2.9 to 2.6 to 2.5. The smallest yield was obtained from the youngest series. Also the yield in the new moon series decreased correspondingly from 1.4 to 1.2. We omitted to sow a third series for the new moon because we considered the season too far advanced.

In the year 1934 the full moon tomatoes yielded an increase by more than 100%. The weight of a single tomato sown two days before full moon was between 280 and 350 grams (9-12 oz.) ; of a single tomato sown two days before new moon 120-180 grams (4-6 oz.).

Considering the experiments of many years we can recommend with good conscience that tomatoes should be sown two days before full moon.

As a general rule we observe that the seeds sown two days before full moon push through the soil very quickly in a few days time. Seeds sown two days before new moon take a much longer time. In most cases we find that those seeds **wait in the soil for the next waxing moon**. But even if they wait until the next full moon to germinate, they do not benefit from the full moon so much, as the seeds which have been sown right from the beginning at the right time. The time which they spend waiting beneath the soil, somehow weakens their life-force.

The experiment with maize has been repeated by a farmer in East Africa (Kenya) and he sent the following report : " During the maize crops I have found the fact spontaneously proved that Maize planted with the waxing moon yielded 30-40% more, than the one planted in the waning moon. Also here the differences between one or two days before full moon, and one to three days before new moon are greatest."

How can we explain the fact, that by sowing two days before the new moon we get just the opposite effect to that obtained by sowing two days before full moon ?

At full moon the forces of the moon are just beginning to decrease. Two days before the moon is full, we are in a stream of energy striving towards the maximum strength. It is therefore necessary to sow two or three days before the moon is full if we want to benefit from all the moon can allow to stream into the life-forces of plants.

On the other hand if we want to get the strongest effect of the new moon forces, it would be wrong to sow exactly at new moon, because then the moon forces are just beginning to increase. The stream of decreasing moon forces is used, if we sow two or three days before the new moon.

There is an old peasant saying: all crops ripening above the soil should be sown during the waxing moon and all crops ripening beneath the soil should be sown during the waning moon. We tried to find out whether this rule is true. We made many experiments with beetroots, carrots, kohlrabi, radishes, etc., sown two days before full moon, and two days before new moon. The result was that we got bigger and more carrots, beetroots, kohlrabi and radishes from the full moon crop.

Now we come to another interesting fact. Certainly we would be wrong if we only take into consideration the **quantity** and do not also study the **quality** of our various experimental crops. Let us take, for example, one of the full moon

carrots, and one of the new moon carrots ; cut them with a knife and watch the surface. The full moon carrot becomes watery immediately after cutting ; the new moon carrot remains dry. Now, if you taste, you will find a rather sweet, mild flavour in the full moon carrot, and a more bitter and sharp taste in the new moon carrot. Looking carefully at the skin of the carrot, you notice that the full moon carrots have a smooth surface ; the new moon carrots are often wrinkled and shrunk. This is a sign, that the one is fully penetrated by the watery element, and that the other is more dry ; this is connected with the difference in taste.

A similar effect will be found in cutting radishes, kohlrabi and beetroots.

It seems to be a natural law that full moon forces bring more of the watery element into the fruits. Once we have understood these laws, we shall be able to master them.

There are two possibilities of error. If we sow two days before full moon and there has been too much rain before and after sowing, the fruits may become too watery and easily get putrid. On the other hand, if we get too much of the new moon forces into the germinating plants, the other extreme is likely to happen : the fruits become too dry. For instance sowing kohlrabi two days before new moon, results in getting a certain percentage of woody plants ; this never happens if sowing takes place two days before full moon.

The moon quarters have an intermediate position, as can be seen from many experiments.

When we have an exact **science** of this relationship between the moon and all that is watery on earth, it will be possible to sow plants every year in such a way that the most favourable results can be obtained.

It is quite obvious that cucumbers, vegetable marrows and similar vegetables respond enormously to the influence of the waxing moon. Also, experiments carried out on a larger scale by some farmers proved an increased crop of 25% for **wheat, barley, oats** and other cereals if planted two days before full moon, in comparison with those planted two days before new moon.

Peas and beans also produce up to 80% larger crops if sown two days before full moon. Fig. 5 demonstrates the different growth of peas sown two days before new moon, (right side) ; and a fortnight later, two days before full moon (left side).



FIG. 5.—EXPERIMENT WITH PEAS.

two days before full moon

two days before new moon.

The new moon series has been planted earlier, still the photograph indicates that the plants are scarcely half as big as the younger full moon series. Later on, the pods turned yellow sooner and the peas began to shrink in the new moon series.

We have mentioned already the experiment of a farmer in Kenya with Maize. Another friend staying for some time in South America, stated, that there also the native population knew about the importance of the lunar influence. They sow their seeds three days before full moon, and transplant three days after new moon. They also observe the tides. They never cut a tree during the flood, or else the tree would "bleed", and be damaged. They find out the tides by cutting into a banana leaf. If the juice begins to flow out of the leaf, then it is the time of the flood.

During my travel in India I tried to find out as much as I could about old customs, or still practised customs connected with the moon. Wherever I asked, people began to tell about the new moon, never about the full moon. There are many rules about the new moon. The new moon day is even an official holiday. Nobody would undertake a journey or do business when the moon is new. One does not even call a doctor, because the cure could not be successful if the doctor starts the treatment on a new moon day. There is one special new moon in the year, when no child may be born. Should this happen, everybody is convinced that the child will have a bad character and may become a thief or even worse. It is interesting then to find out that there is also a special month during which no marriage can take place; and if this rule is observed, then there is no possibility that a child will be born at that unlucky new moon.

During a visit to a hospital in Madras I had an interesting talk with the English doctors residing there. I told them about my experiments concerning the influence of the moon and asked if they were able to tell me something about the native customs there. At first they did not remember anything, but later they told me the following story: A woman patient was completely cured, and the time was fixed for the husband to come and fetch her. The husband came, but he declared he would not take his wife home that day. She could only leave the hospital the next day. Why? It was new moon day, and if the wife left the hospital when the moon was new, she would fall ill again.

Furthermore the doctors told me, that the Indians believe, that, if, during the critical stage of an illness, a new moon day occurs, then the patient will inevitably die. And, strange to say, the doctors added, that this really had happened several times.

In Travancore (southern India) I once asked an Indian who began to speak about the new moon, why I never heard anything about the full moon. He smiled and said: "You see, the full moon is always good, we need not speak about it. But you must be careful about the new moon."

Of course the modern, educated Indian, who is very proud of his English degree, does not like to speak any more about the influences of the moon. Western Science has taught him that these old traditions are not true, not scientific. I shall never forget an interview I had with an Indian professor at Madras University. I gave several lectures about the "Influence of the Moon on Plant Growth" in Madras; and, talking with this professor, I felt that he grew more and more uneasy. "Your experiments are really very interesting, and, of course, I believe you are right; but you see, I find them dangerous."

That was the first time I had ever heard that my experiments were "dangerous." Why? Because the Indians are just beginning to learn to forget their old traditions. They want to be scientific! And if it is true, that the moon has an influence on plant growth, then people will say: "then all our other traditions are also true." And that is not possible. There are so many things which cannot be true.

It is precisely one of the tasks of a true scientist to find out what is true, and when he has found it, to say so, even if it does not please people. . . .

In the annals of the Royal Botanical Garden, Peradenia, Ceylon X 1907 there is a report by A. S. Smith about the influence of the phases of the moon on the cutting of bamboo; and a similar article from E. P. Stebbing an Indian Forester, 1906. We are told that in India, Ceylon, Colombo, it is known that the phases of the moon influence the **quality** of the wood. Trees cut during full moon are full of sap and this means that the wood is easily attacked by insects and worms; not so the wood of trees cut during new moon. This phenomenon we find mentioned in Pliny. He speaks about **oak trees**. They should be cut during a new moon.

In **Brazil** the negroes only cut trees during new moon if the wood is needed for building purposes. There was a custom of marking the wood with a "**moonstamp**" to testify that it had been cut during the right phase of the moon.

In Europe also people familiar with the properties of wood, know when trees should be cut. Years ago a professor of the Technical High School in Stuttgart (Württemberg) came to see me in the Biological Institute at the Goetheanum, and asked me some questions. He had heard that I was studying the influence of the moon on plant growth and had published a book on this subject. Now it often happened to the professor, when he needed wood, that the forester said: "It is not possible to cut the trees now. The wood cutters would not do it, because we have not the right moon." Then I explained why the wood cutters were right. During the full moon the tree is full of growing energy—sap—and it is almost impossible to get the wood dry if the wood is cut during this period, and the wood cannot be used for working purposes; it is not even of much use for fuel. But when trees are cut during the waning moon, then the wood gets dry easily and can be used for furniture-making and other purposes. Only people living in towns, far away from nature and plant life, who treat such laws as superstitious nonsense, think it is possible to fell trees at any time of the year.

The well-known scientist Professor Karutz sent me the following notes on his observations about the influence of the moon in the tropics:

"The influence of the moon on trees is so enormous, that in the trade with wood, the buyer always makes a condition, that the trees are cut during the waning moon. If the trees are cut during the waxing moon, they are quickly attacked by worms and the wood is spoilt."

"Fish caught during full moon get putrid exceedingly quickly. Fish bought in the morning at the market can perhaps still be cooked at noon, but cannot be kept until evening; it would have fallen to pieces by about 7 o'clock in the evening. Sometimes it is not even possible to eat the fish at noon. It gets too soft."

"About 8-10 days after full moon we observe that the full moon has caused the sap to flow into the plants; they develop quickly growing new shoots. This happens, according to the kind of plant, every 4th, 8th, or 12th week."

"We also noticed here (about 11 degrees from the equator) that we could stay in our boats on the water during moon light only on two evenings. After this time the influence of the moon on the water was so great, that the water moved violently, and we did not find it pleasant to stay in the boats. If the moon (after full moon) rises later than 9 o'clock in the evening, a more or less strong wind moves the water, and the movement only dies down again after the moon has risen for some time above the horizon."

"People who fall asleep in their chairs during the full moon wake up with swollen faces."

"Sick people feel their condition much worse during the full moon. These are very strange occurrences which we can observe in the tropics."

"I have also been told that on old bills for Bordeaux wine a note used to be printed saying that the barrels had to be filled according to the phases of the moon if one wanted to keep the wine in a good condition."

Chapter III.

EXPERIMENTS WITH WHEAT FROM 1 TO 16 METRES BELOW THE SURFACE OF THE SOIL, TO DETERMINE THE INFLUENCE OF THE MOON.

Perhaps it may seem strange to the reader, that an attempt should be made to look for the influence of the moon even below the surface of the soil. But this problem as to what happens deeper down in the soil, does arise, if one has studied the influence of the moon for years with various objects, both in laboratory tests and in the open. Are those influences traceable also beneath the surface of the soil to the same extent? Are they weaker, or perhaps do not exist at all? Is there a limit to be found?

For some other experimental purposes our assistant, Mr. W. Kaiser, dug a hole about 7 metres deep. Some years later a still deeper hole was dug out (16 metres). It was about $1\frac{1}{2}$ metres square and one person could just descend—not very comfortably—on a vertical ladder. The natural underground conditions had to be kept undisturbed as much as possible. That meant that light and air had to be excluded as perfectly as possible. At each second metre, the hole was closed again by a wooden cover, while, the surface of the hole was of course kept permanently closed, being bolted by strong wooden bars.

To make quite sure that no influence of light and air, could enter another smaller channel was dug each metre down, parallel to the surface. To make this quite clear: one deep hole was dug vertically, descending 16 metres. At a distance of every metre, horizontal channels were cut in. The distance between the last two channels was 1.5 metres; that means we had 15 channels distributed over 16 metres. These horizontal channels were again bolted with wood against the vertical channel. On opening the first cover for only a few moments, light and air could enter. Descending, we always immediately shut the first cover, and stood on a wooden board offering just enough space to open the horizontal channel into which the various experiments were placed. Standing on the ladder, the floor of the first two metres could be lifted. We descended, shut the cover, and so on, until we reached the eighth sub-division, 16 metres below the surface of the soil.

Each horizontal channel contained a thermometer to record the temperature, and a hygrometer to show the humidity.

These experiments were very difficult to carry out. The arrangement was rather primitive; there was no security against accidents; no fresh air was available during the whole time we had to work below the surface of the soil. In the beginning it took about $\frac{3}{4}$ of an hour to complete the descent and ascent. It was interesting to watch the psychological and physiological effect caused by this experiment. Mr. Kaiser used to describe the effect the digging had on him physiologically in a very drastic way. The deeper down he went, the more conscious he became not only of his physical body, but of all the liquids moving inside. Then head-aches started, terrific head-aches which lasted for many hours. When he had finished the hole, he told me quite frankly: "Of my own free will I will not enter that hole again. I will go only if I must."

Now it was my task to go down with the experiments. Each week one set of plants went down and another set had to be measured, according to the phases of the moon. For some time experiments dealing with the study of the forces of crystallisation were carried out every day. The first experience I had was quite strange. When I descended I found the atmosphere damp, and there was a rather mouldy smell; some little creatures, earthworms and centipedes dropped on my head. Suddenly I began to yawn. That was most astonishing. Normally I never yawn, not even after working through several nights! The deeper I went, the more I had to yawn. Then I became aware of my head. I cannot say that my head ached; perhaps I describe my feelings best by saying, I felt that I had a head. I experienced no difficulties with breathing. When I came out again to the surface, I felt a little giddy, there was a strange heaviness in my head; and oh! I was tired, tired to death. That is not pleasant, if you have to experience it every day. I remained tired the whole day, and only slowly did my head become clear.

Then there came the day, when I thought I heard water running. Quite distinctly, close to me, I was sure there was running water. I heard the little noises of dropping and trickling water. It took me some time to find out that it was the fluids in my own body.

Another time I heard a distinct knocking, and wondered where the knocking came from. It could not possibly be somebody outside who was calling me. Of course not: it was my own heart!

The difference of the seasons is felt very strongly underneath the soil. There are always changes in the atmosphere. For instance in summer-time on descending you feel it is beautifully cool underneath the surface. In Winter time the opposite happens, it is much warmer than outside. Sometimes I had difficulties with breathing, and one day I simply could not go on. Having reached the bottom of the hole, I felt exhausted and still could not make up my mind to ascend; so I finished the work at 16 metres and $14\frac{1}{2}$ metres. Slowly climbing up, I thought that having succeeded with the work at 16 metres it should be easier to work

at 12 and 13 metres. But it became worse and I wondered if it would be any use ringing the little bell which would announce that I did not feel well. Soon I abandoned that thought. The laboratory was far from the hole and the nearby school was often ringing bells; so by the time my friends might find out that it was I who was calling for help, it would be much too late. Then I rushed up the ladder as quickly as I could, and sat panting outside the hole. Ten minutes later I descended again; still I could not go on working. Tired and with an aching head, which seemed to be quite a separate living being, I went home.

The experiments had to be carried out. I began to think that perhaps it was not really as bad as all that beneath the soil; that I was exhausted after having undergone this procedure for many months. So I tried, for the first time, to send somebody else down: a perfectly healthy young girl, a student, who had asked me again and again to let her try. She went down and I remained to look after her. Feeling responsible, I climbed down also and asked if she still felt well. For the first eight metres she called back that everything was all right. At ten metres I heard her breathing heavily, but she was still assuring me it was all right. At 12 metres she began to gasp, and I recalled her immediately. So that was that. Even somebody fresh and healthy could not succeed.

Then, my assistant, Mr. Kaiser, had to complete the experiment. But he also complained later on of feeling very poorly. Something must have been wrong on that special day. I had to find out the reason. The calendar told me it was the 24th of December, 1931, one day before full moon, nothing else. The next day I went down again to make crystallisations and changed the plants. The same thing happened—only I had made up my mind to go through with it; and, in any case, during the Christmas holidays, I had to work alone. Day after day I had the same experiences—until January the 7th. Quite suddenly the hole was in normal condition again.

I am glad that I went through all these experiences without using artificial breathing apparatus, or any other help, because only thus is it possible to get the complete picture, in uniting the objective and subjective phenomena. These experiments were carried out for nearly five years without any interruption.

Of course, plants which are growing underneath the surface of the soil, show certain phenomena corresponding to dark-room experiments. The leaves are yellow instead of green; the first leaf develops much longer than the second. The second leaf just pushed through, and it was not worth while to take the measurement. We recorded only the length of the first leaf and the length of the roots

As mentioned before, the seeds have to be selected very carefully to obtain reliable results. The seeds were inserted in glass dishes in garden soil (the same we used for all our laboratory experiments) containing no artificial fertilizers.

2	Metres	Temp.	Metres	Temp.	Metres	Temp.	Metres	Temp.	Metres	Temp.	Metres	Temp.	The actual figures for one such experiment are : —
	1	1°C	2	12°C	3	12·5°C	4	13°C	5	13·5°C	6	13°C	
	Leaf	Root	Leaf	Root	Leaf	Root	Leaf	Root	Leaf	Root	Leaf	Root	
	2·0	6·5	12·5	14·2	13·5	15·2	19·0	17·2	17·0	15·0	15·8	14·2	
	2·0	5·5	13·0	17·0	15·0	14·5	20·0	15·8	18·2	16·0	17·0	14·2	
	2·7	6·7	12·6	15·0	15·6	17·0	22·0	15·2	18·5	15·0	15·7	14·0	
	2·0	6·4	12·5	11·4	16·0	15·0	21·0	15·0	20·0	17·0	16·3	17·5	
	2·0	4·0	11·4	14·4	15·0	12·5	18·0	15·5	21·0	16·8	16·2	17·5	
	1·5	5·0	11·3	13·0	13·8	14·8	19·4	14·3	18·8	15·5	17·0	16·5	
	1·6	6·0	11·8	14·0	14·8	14·0	22·0	17·0	21·0	17·0	16·3	15·0	
	2·0	4·0	13·0	13·5	16·0	17·0	22·0	16·8	18·0	14·6	17·2	16·8	
	2·0	6·5	11·0	13·0	15·5	15·5	20·0	17·0	18·0	13·6	16·0	16·8	
	2·5	6·5	12·8	14·0	16·0	16·7	21·0	17·5	18·0	14·0	15·0	14·8	
	1·4	5·5	13·0	14·0	14·0	14·8	19·0	15·0	18·0	14·5	15·5	15·0	
	2·0	7·0	12·8	14·0	16·2	16·3	20·0	16·5	18·0	16·8	16·0	17·0	
	2·5	4·0	11·4	13·0	16·5	15·5	21·0	16·0	17·6	17·0	16·2	16·0	
	2·0	5·4	11·8	15·0	16·0	17·0	20·0	15·2	18·8	16·0	17·5	14·4	
	2·0	4·0	12·8	14·0	15·8	16·5	22·0	17·0	19·0	17·4	15·8	17·0	
	2·0	5·6	11·5	13·5	15·0	15·5	19·2	16·5	21·0	16·8	17·4	16·8	
	2·5	4·8	12·0	14·6	13·8	12·0	21·0	17·4	21·0	17·2	16·8	17·5	
	1·9	5·0	11·6	13·8	15·5	14·7	21·5	16·7	20·0	16·8	16·0	14·5	
	2·2	6·0	10·5	14·0	15·0	15·4	18·6	15·0	19·0	14·5	16·6	16·0	
	2·0	5·4	11·0	13·2	15·2	15·8	20·0	15·9	22·0	14·8	15·8	16·8	
	41·0	109·8	269·5	274·8	306·0	305·7	406·7	322·5	382·9	318·5	326·3	318·5	
	Average		Average		Average		Average		Average		Average		
	2·08	5·49	12·9	13·9	15·30	15·28	20·3	16·1	19·1	15·9	16·3	15·9	

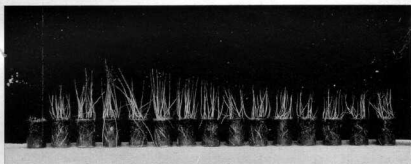
Metres	Temp.	Metres	Temp.	Metres	Temp.	Metres	Temp.	Metres	Temp.	Metres	Temp.
7	13.5°C	8	13.5°C	9	12.5°C	10	12.5°C	11	12.0°C	12	12.5°C
Leaf	Root	Leaf	Root	Leaf	Roots	Leaf	Roots	Leaf	Roots	Leaf	Roots
15.8	17.5	13.6	14.0	11.5	12.0	12.0	13.8	11.7	14.0	9.5	13.2
14.0	15.0	14.5	14.0	12.8	12.0	10.0	10.0	12.0	11.5	10.0	10.0
16.0	18.0	12.8	15.8	11.6	12.5	13.0	13.0	10.0	11.5	9.8	10.0
14.8	16.2	12.5	16.0	12.0	15.0	12.0	11.0	10.7	14.0	11.7	12.5
13.8	15.0	13.0	15.0	12.6	14.6	12.5	12.0	10.7	11.8	9.6	12.5
14.2	13.6	14.3	15.0	11.6	13.5	10.6	10.0	11.2	13.8	10.2	12.5
16.8	15.7	12.5	13.5	12.8	12.6	10.8	11.0	11.3	13.3	11.0	12.0
16.5	16.2	12.0	14.3	13.8	15.2	11.0	11.2	10.8	10.0	9.8	12.6
15.5	14.6	13.0	15.6	12.6	12.8	11.0	12.0	11.5	13.0	11.0	11.2
14.8	16.2	12.0	14.8	13.0	15.8	13.0	13.2	12.0	13.8	11.6	13.0
15.6	13.0	13.5	14.0	12.6	13.3	11.0	12.8	13.0	14.2	10.2	13.0
16.0	15.8	14.8	16.0	11.3	13.5	12.0	13.5	12.0	14.3	9.8	11.0
14.0	16.0	12.8	12.0	11.0	14.5	11.6	12.5	11.3	11.3	11.6	13.5
16.0	14.8	12.0	12.0	13.2	14.0	12.1	12.8	10.0	10.0	10.0	14.0
15.0	16.6	12.0	12.0	12.6	14.8	10.0	11.5	10.0	11.5	11.3	15.8
13.8	13.5	12.8	16.0	11.8	12.8	13.0	12.0	11.0	13.8	11.6	12.5
13.8	14.0	13.6	12.0	12.3	15.3	12.6	14.2	11.0	13.0	11.0	10.2
16.0	15.0	12.0	12.0	12.2	14.0	11.0	10.8	12.5	11.8	9.0	11.6
14.8	17.0	12.0	11.0	12.6	13.8	10.6	12.2	12.0	12.5	11.7	12.0
14.8	14.5	14.0	16.5	12.4	14.6	11.0	14.3	11.0	12.8	11.0	14.0
302.0	308.2	259.7	281.5	246.3	276.6	230.8	243.8	225.7	251.9	211.4	247.1
Average		Average		Average		Average		Average		Average	
15.1	15.4	12.9	14.1	12.3	13.8	11.5	12.2	11.3	12.6	10.6	12.4

Metres	Temp.	Metres	Temp.	Metres	Temp.
13	12.0°C	14½	12.0°C	16	12.0°C
Leaf	Roots	Leaf	Roots	Leaf	Roots
10.3	14.2	9.5	11.0	11.5	13.0
11.0	13.3	10.3	12.0	10.8	12.2
10.8	12.0	11.0	12.6	11.3	13.2
10.0	10.0	11.0	13.0	11.0	11.5
12.2	12.5	10.0	11.2	11.0	13.0
12.0	13.0	9.0	10.2	11.0	11.3
11.5	11.5	10.2	13.0	9.6	10.5
9.3	12.0	9.2	10.3	9.8	11.8
9.2	11.5	11.3	10.8	10.8	12.5
10.2	12.5	9.2	12.5	10.6	11.5
10.0	13.0	10.6	12.8	12.0	12.8
10.2	12.5	9.8	10.0	12.5	11.3
10.6	13.5	10.8	12.2	9.6	12.5
10.0	10.0	10.0	11.5	10.7	12.0
9.0	11.3	10.0	12.8	9.8	11.3
10.3	12.5	10.0	12.8	9.2	12.0
11.2	12.5	9.8	13.2	10.8	11.2
11.3	12.8	9.5	11.0	9.3	10.0
12.0	12.2	9.5	10.2	11.2	11.7
10.4	12.3	10.0	12.4	11.4	11.2
211.5	245.1	200.7	235.5	213.9	236.5
Average		Average		Average	
10.6	12.3	10.0	11.8	10.7	11.8

Following we reproduce a photograph of this experiment together with the respective figures.

The 23rd December, 1932 :

Metres :	1	2	3	4	5	6	7	8
Temp. :	3°	12°	12·5°	13°	13·5°	13°	13·5°	13·5°
Leaf :	2·05	12·0	15·3	20·3	19·1	16·3	15·1	12·9
Roots :	5·49	13·8	15·2	16·1	15·7	15·9	15·4	14·1
Metres	9	10	11	12	13	14½	16	
Temp. :	12·5°	12·5°	12°	12·5°	12°	12°	12°	
Leaf :	12·3	11·5	11·3	10·6	10·6	10·0	10·7	
Roots :	13·8	12·2	12·6	12·5	12·3	11·8	11·8	



Metres 1 2 3 4 5 6 7 8 9 10 11 12 13 14½ 16

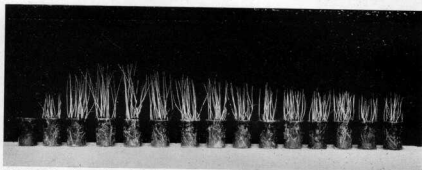
FIG. 6.—Wheat grown beneath the surface of the soil.

The figures for each glass dish show convincingly that the seeds have been selected in such a way that the individual differences are negligible. The average obtained for each pot is reliable.

Looking at the photograph we notice that the first metre with 3°C produced only tiny plants, scarcely visible; the next metre has considerably increased the temperature and growth. Again we are astonished that the small difference of half a degree at the third metre enhances the plant growth so much. Again with half a degree more at the 4th metre, the plants are still bigger. Again half a degree more in the fifth metre and the plants become smaller. The 6th metre has 13 degrees; the warmth corresponds with the 4th metre, but here we get 20·3 cm. and there only 16·3 cm. Therefore we cannot explain the difference in growth by the differences in temperature. That is the first thing one finds out in looking at this experiment. Of course it is justifiable to say that the first metre, with only 3 degrees of warmth, offered too unfavourable conditions for the seeds, so here the difference is due to the temperature. We may also explain the increased growth which follows, with the difference from 3 to 12 degrees; only further on we cannot use this explanation.

We try another week. The 3rd January, 1933 :

Metres :	1	2	3	4	5	6	7	8
Temp. :	6°	12°	12·5°	13°	13°	13°	13°	12·5°
Leaf :	1·0	10·0	15·5	18·2	19·2	18·1	15·8	14·3 cm.
Roots :	4·2	12·6	15·0	16·1	16·6	14·6	14·0	12·9 cm.
Metres :	9	10	11	12	13	14½	16	
Temp. :	12·5°	12·5°	12·5°	12·5°	12°	12°	12°	
Leaf :	12·9	12·4	11·4	10·9	11·3	10·9	10·4	
Roots :	13·5	12·6	12·5	11·5	12·4	12·2	10·9 cm.	



Metres 1 2 3 4 5 6 7 8 9 10 11 12 13 14½ 16

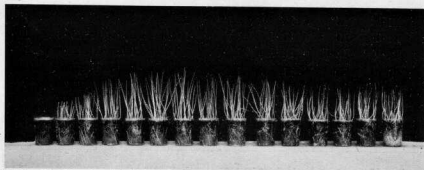
FIG. 7.—Wheat growing below the surface of the soil.

The photograph looks similar. The plants increase in growth until the fifth metre, but the temperature increases only up to the 4th metre ; then it remains steady until the 7th metre, but the plants may either increase or decrease.

The same phenomenon we find between the 8th and 12th metre. The temperature remains steady at 12·5° but growth varies. Again between the 13th and 16th metre, the temperature remains steady at 12° but growth is decreasing.

The 16th February, 1933 :

Metres :	1	2	3	4	5	6	7	8
Temp. :	5°	10°	11°	12·5°	13°	13°	13°	13°
Leaf :	0·6	6·9	10·0	15·4	16·4	16·7	17·0	15·9
Roots :	6·5	9·2	12·3	15·3	14·9	14·8	15·6	15·3
Metres :	9	10	11	12	13	14½	16	
Temp. :	13°	13°	12·5°	12·5°	12°	12°	12°	
Leaf :	15·7	14·7	13·2	13·2	12·3	12	12	cm.
Roots :	15·9	15·1	13·5	13·8	12·5	13·5	12·6	cm.



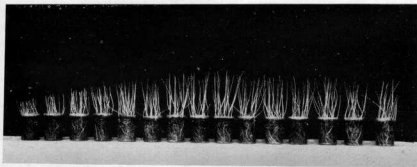
Metres 1 2 3 4 5 6 7 8 9 10 11 12 13 14½ 16

FIG. 8.—Wheat growing below the surface of the soil.

The temperature increases until the 5th metre ; the plants increase in growth until the 7th metre. From the 5th to the 10th metre the temperature remains steady, but the plants vary in growth.

The 24th of April, 1933 :

Metres :	1	2	3	4	5	6	7	8
Temp. :	8·5°	11°	11°	11·5°	11·5°	12·5°	12·5°	13°
Leaf :	7·0	8·0	9·3	12	12·3	13·9	15	15·5
Roots :	9·8	11	12·6	14·2	15	18·7	17·3	17·9
Metres :	9	10	11	12	13	14½	16	
Temp. :	12°	13°	13°	12°	12·5°	12°	12°	
Leaf :	16	15	15·6	13·6	14·2	13·2	13·6	
Roots :	18·2	18·2	16·6	16·6	16·9	16·2	15·2	



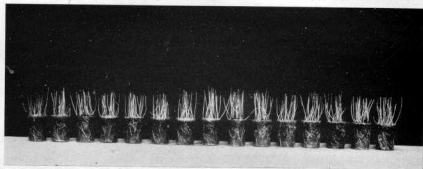
Metres 1 2 3 4 5 6 7 8 9 10 11 12 13 14½ 16

FIG. 9.—Wheat growing below the surface of the soil.

The plants increase steadily until the 9th metre. The temperature is the same at 2 and 3 metres deep ; at 4 and 5 metres ; at 6 and 7 metres ; it reaches the maximum at 8 metres ; it decreases at 9 metres, where the plants reach the maximum ; increases again at 10 metres, remains at 11, decreases at 12, increases at 13 and decreases again at 14½, remains at 16 metres.

The 8th June, 1933 :

Metres :	1	2	3	4	5	6	7	8
Temp. :	12·5°	13°	12°	12°	12°	12·5°	12·5°	12·5°
Leaf :	10·5	10	10·1	10	10·5	10·3	10·3	11·9
Roots :	12·9	12·5	12·1	11·7	12·3	11·7	11·1	13·9
Metres :	9	10	11	12	13	14½	16	
Temp. :	12·5°	12·5°	13°	12·5°	12·5°	12°	12°	
Leaf :	11	11·3	11·1	11·3	10·7	10·1	10·5	
Roots :	13·6	13·2	12·9	13·1	13·7	12·4	12·3	



Metres 1 2 3 4 5 6 7 8 9 10 11 12 13 14½ 16

FIG. 10.—Wheat growing below the surface of the soil.

This is a very interesting experiment. Nearly all the plants have the same height.

The following week, June, 14th shows an other interesting phenomenon :

Metres :	1	2	3	4	5	6	7	8
Temp. :	13°	12°	12°	12°	13·5°	12·5°	12·5°	13°
Leaf :	14·8	11·7	11·7	11·3	10·9	11·8	12·4	13·1
Roots :	16·7	14	14·7	12·6	12·9	13·1	14·2	14·3
Metres :	9	10	11	12	13	14½	16	
Temp. :	13·2°	13°	12·5°	12·5°	12°	12°	12°	
Leaf :	12·6	12·2	12	11·7	12·1	11	11·8	
Roots :	14·1	14·5	13·3	13·4	13	12·9	12·9	

The third sketch (Fig. 30) illustrates what would happen in winter. 8 hours during the night are too much.

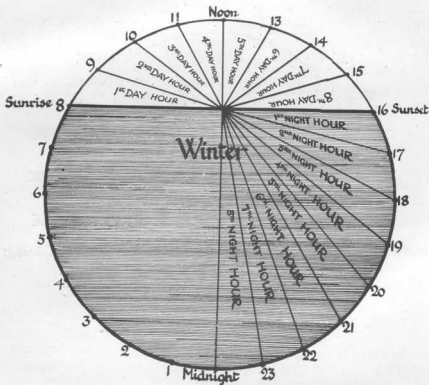
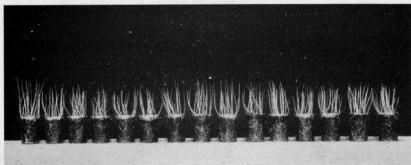


Fig. 30.



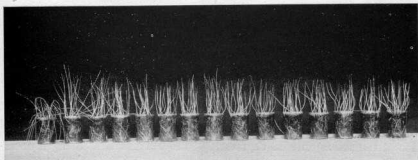
Metres 1 2 3 4 5 6 7 8 9 10 11 12 13 14½ 16

FIG. 11.—Wheat growing below the surface of the soil.

The plants decrease at first and then increase again. The temperature decreases from the first to the second metre; then remains steady until the 4th metre; increases again and reaches the maximum at 5 metres; decreases at the 6th metre, remains steady at the 7th; increases at the 8th and 9th; decreases at the 10th and 11th; remains at the 12th and decreases once more at the 13th; then remains steady to the end.

A month later, on the 14th July, 1933 :

Metres :	1	2	3	4	5	6	7	8
Temp. :	10°	14.5°	14.5°	15°	14°	13.5°	13.5°	13°
Leaf :	21.4	19.4	17	13.8	13.2	12.2	13.8	14.5
Roots :	15	15.9	15	13.8	14.2	14.9	14.5	15.4
Metres :	9	10	11	12	13	14½	16	
Temp. :	13°	12.9°	13°	12.8°	12.5°	12.4°	12°	
Leaf :	14.4	13.6	12.8	13.8	13.1	12.7	12.7	
Roots :	15.1	14	14.3	13.6	14.4	13.2	13.4	



Metres 1 2 3 4 5 6 7 8 9 10 11 12 13 14½ 16

FIG. 12.—Wheat grown below the surface of the soil.

The 14th July (*continued*).

We find the first pot has developed such long leaves that they cannot stand upright, they droop. Of course this is due to the fact, that plants lacking sunlight are very much weakened. In the second pot they stand upright, the leaves are smaller. Then we find decreasing growth until the 6th pot. The 7th and 8th increase again; and again the growth decreases.

The temperature however is **lowest** where the plants are **biggest**. The first metre registers only 10°C, the second and third 14½ degrees. The maximum temperature is reached with 15 degrees at the 4th metre.

Again a month later, on the 13th of August, 1933 :

Metres :	1	2	3	4	5	6	7	8
Temp. :	12°	16°	15.5	15°	14°	13.5	13.3	13°
Leaf :	28.6	29.2	29.4	29.9	25.8	24.8	25.6	25.3
Roots :	15.9	16°	16.9	17.5	16.0	14.6	16.9	16.8
Metres :	9	10	11	12	13	14½	16	
Temp. :	12.5	12.5	12.5	12.5	12.5	12.4	12°	
Leaf :	24.8	23.8	23.6	23.7	24.3	23.0	21.9	
Roots :	19.6	17.3	17.7	17.0	16.9	16.5	14.5	

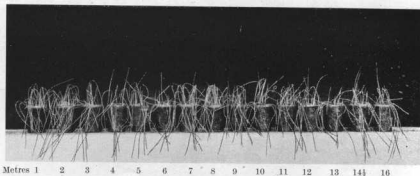


FIG. 13.—Wheat growing below the surface of the soil.

All the plants have drooping leaves. The temperature 1 metre below the surface of the soil is only 12 degrees, still the plants reach a length of 28.6 c.m. The second metre has the maximum temperature of 16 degrees; but the maximum growth is reached at 4 metres.

September 11th, 1933:

Metres :	1	2	3	4	5	6	7	8
Temp. :	16°	17°	16°	14.5	14°	13.2	13°	13°
Leaf :	28.8	28.4	27.3	20.1	17.7	12.0	10.9	5.8
Roots :	16.9	17.7	13.9	14.5	14.6	11.7	12.2	7.1
Metres :	9	10	11	12	13	14½	16	
Temp. :	13°	12.5	12.5	12.5	12°	12°	12°	
Leaf :	7.7	11.9	10.7	9.2	5.8	10.1	10.9	
Roots :	9.3	11.5	10.4	10.4	6.8	10.8	10.9	

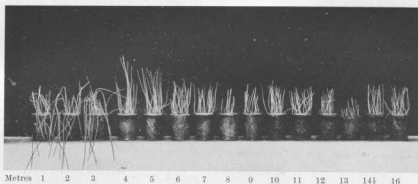


FIG. 14.—Wheat growing below the surface of the soil.

Only the first three pots show the phenomenon of drooping leaves. The temperature at the first metre has considerably increased to 16 degrees; and the second keeps the maximum temperature with 17 degrees. Maximum growth is reached at the first metre with 28.8 cm. Then the plants rapidly decrease in length.

If we compare for instance, the growth of the 8th metre with that of the previous month—we have in both experiments the same temperature of 13 degrees—but in August the plants reached a length of 25.3 cm. and in September only 5.8 cm.

October 3rd, 1933

Metres :	1	2	3	4	5	6	7	8
Temp. :	16°	17°	16°	14.5	13°	13°	13°	12.8
Leaf :	27.7	26.6	28.3	23.6	20.7	16.1	15.1	13.4
Roots :	16.1	16.6	18.0	14.7	15.0	13.7	13.7	12.4
Metres :	9	10	11	12	13	14½	16	
Temp. :	12.8	12.8	12.5	12.5	12.5	12.2	12°	
Leaf :	12.6	13.2	10.7	13.3	11.8	12.4	11.0	
Roots :	11.5	13.8	12.5	14.2	13.2	14.9	13.3	

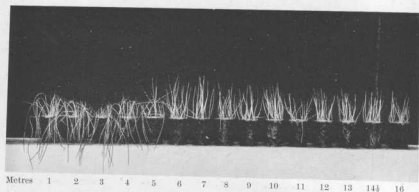


FIG. 15.—Wheat growing below the surface of the soil.

The first 5 pots have drooping leaves. Maximum growth is reached at the third metre with 28.3 cm.; the maximum temperature at the second metre with 17 degrees. Then the temperature slowly decreases, and also the plants decrease in growth.

November 10th, 1933 :

Metres :	1	2	3	4	5	6	7	8
Temp. :	16°	15.5	14°	13°	12.5	12.5	12.5	12.5
Leaf :	17.0	25.0	25.2	24.0	22.5	17.2	15.3	13.5
Roots :	14.0	17.0	16.5	16.7	16.0	14.8	13.0	11.4
Metres :	9	10	11	12	13	14½	16	
Temp. :	13°	12.8	12.9	13°	12.5	12°	12°	
Leaf :	12.8	10.9	12.0	11.2	10.3	11.0	10.0	
Roots :	14.3	13.0	13.0	12.7	12.0	12.0	12.0	

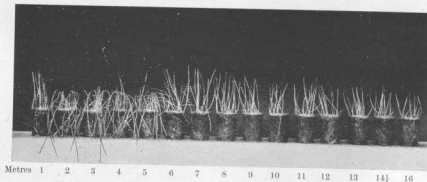


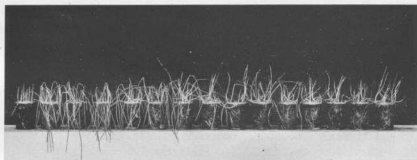
FIG. 16.—Wheat growing below the surface of the soil.

November 10th (*continued*).

The first plants stand upright ; the following 4 pots show the phenomenon of drooping leaves. Then again the plants stand upright, but are slowly decreasing. The maximum temperature at the first metre is 16 degrees ; the maximum growth at the third metre with only 14 degrees.

December 17th, 1933 :

Metres :	1	2	3	4	5	6	7	8
Temp. :	5°	10°	13°	14°	14°	14°	14°	13°
Leaf :	6·6	23·5	22·5	26·9	23·3	23·8	20·4	17·8
Roots :	10·2	12·0	17·4	18·2	16·6	16·1	16·7	16·0
Metres :	9	10	11	12	13	14½	16	
Temp. :	14°	14°	14°	14°	13°	13°	13°	
Leaf :	15·6	16·0	13·0	12·6	13·0	14·5	13·3	
Roots :	16·1	13·7	12·2	13·2	13·5	13·7	12·8	



Metres 1 2 3 4 5 6 7 8 9 10 11 12 13 14½ 16

FIG. 17.—Wheat growing below the surface of the soil.

1 metre deep the leaves are rather small. At the 2nd, 3rd, 4th, 5th, 6th and 7th metres we find drooping leaves, and then gradually growth decreases again. The maximum is reached at 4 metres. The temperature is only 5 degrees at the first metre and reaches the maximum with 14 degrees at the 4th metre ; then remains steady until the 7th metre. It decreases at the 8th and rises again to 14 degrees up to the 12th metre ; then decreases to 13 degrees until the 16th metre.

We notice that the warmth slowly penetrates into the soil. We have an outside temperature far below zero ; one metre beneath the surface of the soil 5 degrees of warmth ; then 10 degrees, then 13 ; and then for some metres the highest temperature of 14 degrees.

The warmth of the summer sun slowly enters the soil and the plants may benefit within the soil from last summer's sun. That is a very important fact.

I would like very much to publish the photographs of all the experiments, but I have to limit myself to these few, and can only hope that it will be possible to include all the graphs.

We will study at first the graph of the temperature, 1931*, 1 metre below the surface of the soil. The graph begins with the third of January and ends with the end of December. It is a harmonious-looking graph, with the minimum between February and March (3 degrees) and the maximum in August.

The following year, 1932, looks similar but it has an individual character compared with 1931. The minimum is at the end of February, the maximum August—September. Immediately afterwards follows a heavy drop and then it rises again nearly to the maximum.

The year 1933 shows a few strange phenomena. The minimum is reached early in January; then it keeps on a level the whole of February and half March, before starting to rise ultimately. Then a sudden drop occurs at the end of June; the temperature remains very low during the whole month of July and part of August. The maximum is reached at the end of October and beginning of November; and in December we have again a very sudden drop.

The year 1934 shows a very steady climbing up to the maximum and gradually drops. The maximum is reached at the end of July and the beginning of August and occurs again in the middle of September.

But looking on all the four graphs again and again, one feels strongly that they should be divided differently. The year 1931 does not really end with the end of December, it ends later—at the end of February. That seems also to be the right beginning for 1932.

The end of 1932 is about the beginning of March, 1933. The end of 1933 is about the beginning of March, 1934. This would be the right division of the graphs.

The same impression is there in studying the temperature during these 4 years, 2, 3, 4, and 5 metres below the surface†. The deeper we go beneath the surface of the soil, the more flat the graph becomes. The differences in temperatures are very slight. The more interesting it is to see that each year has its own specific character. The year 1932, for instance, shows very distinctive changes between the 10th and 16th metres.

Supplement 3 represents the average growth obtained for the wheat plants in the years 1931, 1932, 1933, 1934, one metre below the surface. Above the middle line we have the graph for the leaf, and below the graph for the roots. We may just imagine the grain is lying on the middle line, and the plant is growing

* See supplement 1.

† See supplement 1 and 2 charts for the temperature.

the leaf upwards, and the roots towards the soil. It is clearly seen that the same phenomenon which we noticed in studying the graph for the temperature, occurs also for the plants themselves. It does not seem reasonable to start the year at the beginning of January and finish it at the end of December. The graph looks too long at the left hand side and too short at the right. If we try to subdivide the graph in a natural way, without taking any notice of the time, we find that we have to subdivide at the beginning of March—or more accurately—about the 20th of March, when the sun is entering the Spring constellation. **This is the true beginning of the year.**

For instance if we look at the graph for 2 metres below the surface of the soil, 1934, there is no sense in it, if we stop the graph at the end of December. We must continue 10 more weeks; then the graph seems to be complete; but that also means the middle of March.

This is one remarkable result of these experiments: **we can establish quite objectively the true beginning of the year: the natural year.** It is connected with the sun.

May I remind the reader at this point, that the year did not always begin with the month of January? The Romans, for instance had a year of only 10 months, beginning in March. Of course this year was too short, and then they added two more months. The second month was April, the third May, the fourth June, the fifth was originally called Quintilis (the fifth). In the year 44 B.C. the name was changed to Julius (July) because the birthday of the Emperor Julius, the founder of the Roman Empire fell on the 12th of the month. The following month was called at the beginning "Sextilis"; that is the "sixth"; and, later on, was named after a great Roman Emperor—Augustus Caesar—the month of August. Our present-day names for the months, September, October, November and December, still mean the 7th, 8th, 9th and 10th months of the year. The month of January and February were added later.

So the study of our graphs representing the growth of plants at various depths in the soil, results in the discovery that, for nature, the year obviously does not begin on the 1st of January, but at about the Spring equinox.

What about the moon? Can we also find in our graphs laws connected with the rhythms of the moon? At one metre deep, the maximum is reached during the full moon period in the years 1931, 1932, 1933 and 1934. The result is therefore identical with all our other experiments carried out in the laboratory.

For the sake of comparison we give the graphs for these four years.

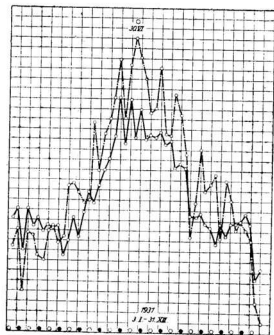


FIG. 18—Graph representing the average growth of wheat during the various phases of the moon in 1931.

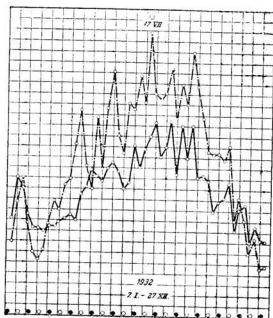


FIG. 19—Graph representing the average growth of wheat during the various phases of the moon in 1932.

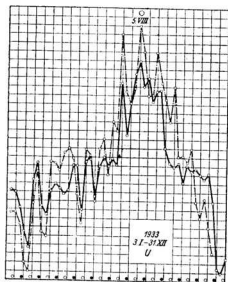


FIG. 20—Graph representing the average growth of wheat during the various phases of the moon in 1933.

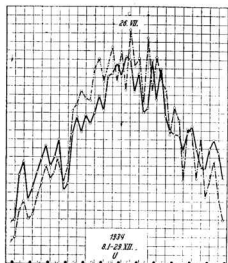


FIG. 21—Graph representing the average growth of wheat during the various phases of the moon in 1934.

2 metres deep : 1931 and 1932, reach the maximum growth during the full moon period. 1933 produces two maxima, the first is reached by plants having grown from waning quarter to waxing quarter ; the second is reached during the new moon period. In the year 1934 the maximum is again reached during the new moon period.

3 metres deep :* 1931 and 1932 the maximum is in the full moon period. In 1933 the maximum is during the new moon period. In 1934 the maximum is reached by plants growing from waning quarter until waxing quarter.

4 metres deep :* The year 1931 has its maximum at a new moon period. The year 1932 has its maximum at a waxing quarter ; the year 1933 has the maximum waxing quarter to waning quarter. The year 1934 has the maximum again at a full moon.

5 metres deep :† The year 1931 has the maximum at the new moon period ; so has the year 1932. In the year 1933 we find 4 points to take into consideration. The first two are reached during waning to waxing quarter respectively and the second two during the new moon periods. The year 1934 reaches the maximum growth during the full moon period.

6 metres deep :† 1931 has one maximum very early in the year during the full moon period, the second maximum during waning to waxing quarter, the third at the new moon period. In 1932 we find an early maximum during the full moon period, and a late maximum during the new moon period. In 1933 there are two maxima and both are during new moon periods. The year 1934 has one maximum during the full moon period.

7 metres deep :‡ The year 1931 has an early maximum during the full moon period and a later maximum during the new moon period. The year 1932 shows the same phenomena. In 1933 the maximum is during new moon period. It is rather difficult to decide for the year 1934 ; the graph is very unquiet. We may say that there is an early maximum during full moon ; later on a second maximum during waning to waxing quarter ; and still later a third one in the full moon period.

8 metres deep :‡ In 1931 an early maximum is reached during a full moon period and a later maximum during a new moon period. In 1932 the first maximum is reached during full moon the second during new moon. In 1933 we find two maxima during the new moon periods. In 1934 the most prominent points are kept by waxing and waning quarters.

9 metres deep :§ In 1931 we find an early maximum during the full moon period, and a later maximum during the new moon period. In 1932 the first maximum occurs during waning to waxing quarter, the second at a full moon and the third at a new moon period. In 1933 the maximum is during the new moon period. In 1934 the first maximum is reached during full moon

* Supplement 4.

† Supplement 5.

‡ Supplement 6.

§ Supplement 7.

10 metres deep :§ In 1931 the maximum is reached during full moon. In 1932 the maximum is during full moon period. In 1933 the maximum is reached during waning to waxing quarter. In 1934 there is one early maximum during the full moon period.

11 metres deep :** In 1931 we find an early maximum during full moon. In 1932 one early maximum during the full moon period and a later maximum during the new moon period. In 1933 the maximum occurs during new moon period, and in 1934 there are two maxima ; the first early during the full moon period, the second during new moon.

12 metres deep :** In 1931 there is one early maximum during the full moon period. In 1932 there is one early full moon maximum. In 1933 the maximum occurs during new moon, and in 1934 two maxima appear ; the first one early during full moon the second during new moon.

13 metres deep :†† In 1931 there is one early maximum during full moon. In 1932 one maximum occurs during the full moon. In 1933 one maximum appears during waxing to waning quarter. In 1934 the maximum is reached during waning to waxing quarter.

14¹ metres deep :†† The year 1931 cannot be decided upon, because there are many weeks when plants did not germinate at all. In 1932 the maximum is during full moon period. In 1933 the maximum is during a new moon period. In 1934 the maximum occurred during a new moon period.

16 metres deep :‡‡ In 1931 the maxima appear during the full moon periods. In 1932 the maximum is during full moon. In 1933 the maximum is during the new moon. In 1934 we find an early maximum during waning to waxing quarter, the second during waxing to waning quarter

The result of this analysis will be explained in detail in the following chapter.

§ Supplement 7.

** Supplement 8.

†† Supplement 9.

‡‡ Supplement 10.

THE CONVENTIONAL YEAR
and the
NATURAL YEAR

POSITIVE AND NEGATIVE NEW MOON.

“ “ “ **FULL MOON.**

It is quite fascinating to study the results of these experiments. We come to the conclusion, that we have to introduce some new terms. For instance we have to discriminate between the **Conventional Year** and the **Natural Year**.

The conventional year begins on the first of January, and ends on the 31st of December. Of course in these charts the beginning accords with the phases of the moon; therefore our year begins, maybe, on the 3rd or 4th of January, and ends perhaps on the 27th of December, but on the whole the conventional dates are adhered to. But a study of the charts induces us to make a different beginning. The natural year starts when the vegetation begins, and ends when we notice the decline of the forces of vegetation. These two different years, the conventional and the natural, are indicated in the charts either through straight or interrupted lines. The interrupted lines enclose the “natural year.” We get a real picture of **increasing plant growth, maximum growth, and decreasing growth**. The natural year always includes these **three facts**. However, if we look at the conventional year, we find, penetrating most deeply into the earth, that sometimes the whole year consists only of the rising section, and reaches the maximum very late; and just at the moment when it begins to decline, the next conventional year commences. Therefore the next year has an extremely long decreasing section, and almost no rising vegetation. That seems completely wrong. On the left hand side, there is definitely a big “tail” belonging to the previous year and on the right hand side the corresponding section is missing.

The following 4 graphs should make this perfectly clear. Fig. 22 represents the growth of wheat plants 2 metres below the surface, in the year 1932. We take at first the “conventional year,” starting on January 7th and ending on December 27th according to the phases of the moon. This graph shows the phenomenon mentioned before, that on the left hand side a piece seems too long, and on the right hand side, the graph seems incomplete.

Fig. 23 represents the plant growth 2 metres below the surface in the year 1932, beginning on the 21st of March and ending therefore on the 18th March, 1933: the **natural year**.

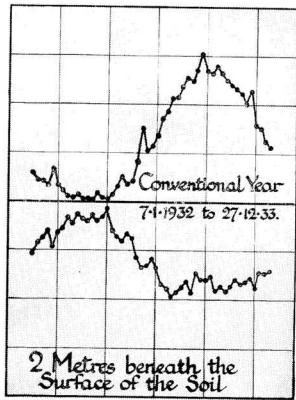


FIG. 22.—Wheat plants grown two metres below the surface of the soil. "Conventional Year."

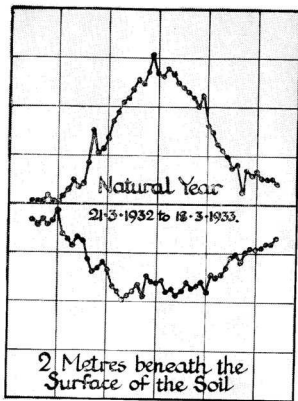


FIG. 23.—Plant growth two metres below the surface "Natural Year."

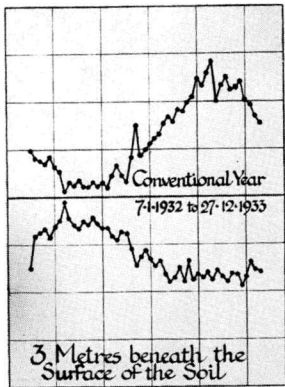


FIG. 24.—Plant growth three metres below the surface,
"Conventional Year."

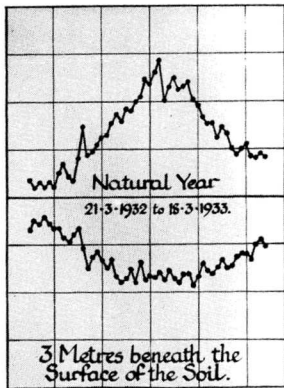


FIG. 25.—Plant growth three metres below the surface,
"Natural Year."

We get the same phenomenon if we try the third metre. Fig. 24 represents the result obtained for the "conventional" year, and Fig. 25 the result obtained for the "natural" year.

The "natural" year is the **real** year for the vegetation. Everyone who is sufficiently interested to study the charts (supplement 2—10) will come to the same conclusion.

We expect that some readers will object that the introduction of the "natural year" makes things still more complicated. It cannot be helped. Nature is complicated, and our task is to try and understand these marvellous hidden rhythms.

We enumerate here the beginning and end of the "natural year" according to the plant growth in the different depths of the soil :

Beginning and end of the "natural year"

Metres	1931/32	1932/33	1933/34	1934/35
1	11.3—7.3	14.3 3.3	10.3—28.2	8.3—4.3
2	25.3—21.3	29.2—18.3	25.3—8.3	15.3—10.4
3	23.4—5.4	13.4—18.3	25.3—13.4	21.4—10.4
4	31.5—5.5	12.5—24.5	1.6—21.4	28.4—9.6
5	8.6—5.5	12.5—30.5	7.6—21.4	28.4—9.6
6	8.7—20.5	4.6—24.5	1.6—13.5	21.5—9.6
7	8.7—4.6	11.6—24.5	1.6—13.5	21.5—9.6
8	8.7—4.6	11.6—24.5	1.6—13.5	21.5—9.6
9	15.7—4.6	11.6—1.6	8.6—20.6	27.6—9.6
10	8.7—4.6	11.6—24.5	1.6—20.6	27.6—9.6
11	8.6—4.6	11.6—24.5	1.6—20.6	27.6—9.6
12	8.6—4.6	11.6—24.5	1.6—20.6	27.6—9.6
13	8.6—4.6	11.6—24.5	1.6—4.6	27.6—9.6
14 $\frac{1}{2}$	1.6—27.5	4.6—24.5	1.6—4.6	12.6—9.6
16	8.6—5.5	13.5—24.5	1.6—12.5	20.5—9.6

This chart reveals to us the interesting fact, that the deeper down we go into the earth, the later the year begins. At first the beginning happens in the month of March, then in April, then in May, then in June, and it may even happen in July.

Spring begins later. This may seem strange. If the year begins later, then also the maximum growth must vary. Therefore these phenomena must be studied as well.

Positive and Negative New Moon or Full Moon :

We may also discover, that each year seems to have a certain point which it aims to reach (we find this indicated in each chart of plant growth in the various depths below the surface of the soil). For some charts we must say the climax is reached with the **maximum growth** ; others are definitely **circling round the minimum**.

This fact asks for the introduction of another expression. For instance: we may find the maximum growth is expressed in one chart during the new moon period, another graph circles round the minimum, and also falls at a new moon period. **These two new moons have a different quality.** The simplest way of discriminating between these two different kinds of new moons seems to be the introduction of the term; positive and negative new moon. To help readers in the study of these experiments, a few statistics follow which show these different qualities of the new moon as negative new moon; —● and the one representing a maximum growth around which the whole chart circles, as positive new moon.

MAXIMUM GROWTH ACCORDING TO THE CONVENTIONAL YEAR.

Metres.	1931	1932
1	28.8 ○	14.9 ○
2	28.8 ○	14.9 ○
3	26.9 ○	14.10 ○
4	2.4 ○ & 10.11 ●	5.11)
5	2.4 ○ & 10.11 ●	18.6 ○ & 28.11 ●
6	2.4 ○ & 10.11 ●	18.6 ○ & 28.11 ●
7	2.4 ○ & 10.11 ●	18.6 ○ & 28.11 ●
8	2.4 ○ & 10.11 ●	18.6 ○ & 28.11 ●
9	2.4 ○ & 10.11 ●	14.4) & 18.6 ○ & 28.11 ●
10	2.4 ○	18.6 ○
11	2.4 ○	18.6 ○ & 28.11 ●
12	2.4 ○	18.6 ○
13	2.4 ○	18.6 ○
14½	2.4 ○	18.6 ○
16	2.4 ○ & 28.8 ○	18.6 ○

Metres.	1933	1934
1	4.9 ○	26.7 ○
2	28.8) & 19.10 ●	8.10 ●
3	21.8 ●	14.11)
4	13.8 (	22.10 ○
5	13.8 (& 17.12 ●	22.10 ○
6	21.8 ● & 17.12 ●	22.10 ○
7	21.8 ●	28.4 ○ & 20.12 ○
8	21.8 ● & 17.12 ●	29.11 (
9	21.8 ●	28.4 ○
10	28.8)	28.4 ○
11	21.8 ●	28.4 ○ & 9.9 ●
12	21.8 ●	28.4 ○ & 9.9 ●
13	13.8)	16.9)
14½	21.8 ●	9.9 ●
16	21.8 ●	21.5) & 16.9)

MAXIMUM GROWTH ACCORDING TO THE NATURAL YEAR.

Metres.	1931/32	1932/33
1	28.8 ○	14.9 ○
2	28.8 ○	14.9 ○
3	26.9 ○	14.10 ○
4	10.11 ●	5.11)
5	10.11 ●	18.6 ○ & 28.11 ●
6	10.11 ●	18.6 ○ & 28.11 ●
7	10.11 ●	18.6 ○ & 17.4 (33) (
8	10.11 ●	18.6 ○ & 28.11 ●
9	10.11 ● & 9.12—● & 14.4)	18.6 ○ & 28.11 ● & 17.4 (
10	9.12—●	18.6 ○ & 12.12—○
11	9.12—●	18.6 ○ & 28.11 ● & 17.4 (33) (
12	9.12—●	18.6 ○ & 17.4 (33) (
13	9.12—●	18.6 ○ & 17.4 (
14½	9.12—●	18.6 ○ & 12.12 —○
16	9.12—●	18.6 ○ & 26.1 (33) —●

Metres	1933/34	1934/35
1	4.9 ○	26.7 ○
2	28.8) & 19.10 ●	8.10 ●
3	21.8 ●	14.11)
4	13.8 (& 31.12—○	22.10 ○
5	13.8 (& 28.8) & 19.10 ● & 17.12 ○	22.10 ○
6	21.8 ● & 17.12 ●	22.10 ○ & 26.2 (35) (
7	21.8 ● & 28.4 (34) ○	26.2 (35) (
8	21.8 ●	26.2 (35) (
9	21.8 ● & 28.4 ○	26.2 (35) (
10	28.8) & 28.4 ○	19.1—○ & 15.5 (35) ○
11	21.8 ● & 28.4 ○	9.9 ● & 26.2 (35) (
12	21.8 ● & 31.12 —○ & 28.4 ○	9.9 ● & 26.2 (35) (
13	13.8 (& 31.12 —○	16.9) & 26.2 (35) (
14½	21.8 ● & 31.12 —○	9.9 ●
16	21.8 ● & 31.12 —○	16.9) & 26.2 (35) (

These statistics show that the maximum growth happens at first between August and September; then in October and November. In 1933 we find it

in December, or it moves even to the following year. So we might say, the Spring begins in June/July, the maximum growth November/December. In 1934/35 the "Natural Year" points to February as having the maximum growth. **On the surface of the earth it is midwinter, and at 6, 7, 8, 9, 10 metres below the surface it is summer-time.**

Again, strange to say, this summer beneath the surface of the soil, **is not indicated by a higher temperature.** We do not find such great warmth as the summer brings on the surface of the earth. Still the plant-growth says: it is summer, the maximum is reached. We cannot say that this maximum is due to warmth. It must be an influence of the sun, not connected with warmth. We see the maximum growth gradually retiring to greater depths. In the first metres we observe even a rise in temperature during winter time. We see that the warmth is slowly entering the soil. But later it is no longer the warmth; the temperature remains steady, yet the plants indicate a difference in their growing capacity.

Now we need to study the influence of the moon. In the experiments carried out in the laboratory for many years the fact could be ascertained that the maximum growth is reached every year during the full moon period. This periodicity is still found **one** metre deep below the surface of the earth, during the years 1931, 1932, 1933, 1934.

At two metres deep only 1931 and 1932 show the maximum growth during full moon periods. In 1933 and 1934 the maximum is reached during new moon periods or waxing quarters. The same happens at 3 metres deep.

From the 5th to the 16th metres there is one smaller maximum on the 2nd of April (**the Easter Full Moon**), and a second maximum in November falling on a new moon period in 1931.

In 1932, one maximum is kept through from the 3rd to the 16th metre on the 18th June, again a full moon period. The second maximum also occurs in November (similar to 1931) on a new moon period.

The year 1933 seems especially favourable for the new moon periods in the month of August; and the year 1934 has more inclination towards the full moon periods, in October, November, December.

Each year has a certain dominating lunar period, but it is no longer only the full moon periodicity which we have learned to know in all the experiments above the surface of the soil. Decidedly an influence of the moon is to be found. Perhaps one could say, the influence of the moon gets weaker the deeper one goes down, but it is still there.

The forces of vegetation on the whole diminish from the 1st to the 16th metre.

Maximum Growth :

Metres	1931	1932	1933	1934
1	32.5 cm.	31.0 cm.	33.0 cm.	40.0 cm.
2	27.0 ..	30.0 ..	31.5 ..	40.5 ..
3	23.3 ..	28.0 ..	32.0 ..	40.0 ..
4	21.0 ..	28.5 ..	30.0 ..	40.0 ..
5	20.5 ..	20.5 ..	25.5 ..	38.5 ..
6	17.0 ..	18.5 ..	25.5 ..	37.0 ..
7	17.5 ..	15.5 ..	29.0 ..	33.0 ..
8	16.5 ..	17.5 ..	26.5 ..	27.5 ..
9	15.0 ..	16.5 ..	28.5 ..	29.0 ..
10	15.5 ..	19.0 ..	25.0 ..	24.0 ..
11	14.0 ..	19.5 ..	25.5 ..	21.0 ..
12	14.5 ..	18.0 ..	24.0 ..	19.0 ..
13	16.0 ..	20.0 ..	25.0 ..	18.0 ..
14 $\frac{1}{2}$		19.0 ..	25.0 ..	19.0 ..
16	15.0 ..	18.5 ..	25.0 ..	17.0 ..

We notice 1931 a drop from 32.5 cm. to 15.0

1932 31.0 .. 18.5

1933 33.0 .. 25.0

1934 40.5 .. 17.0

These experiments beneath the surface of the soil are extremely interesting. I wish they could be continued for many more years, then many interesting laws about plant growth and the universe would be discovered. They are not easy, because the natural conditions have to be kept intact as much as possible. That means that no air from above the soil must enter. No ventilation, no artificial breathing apparatus must be used, or else many interesting phenomena will not be perceived.

THE FORCES OF CRYSTALLISATION IN NATURE.

Something about crystallisation above and below the surface of the soil.

The study of plant growth as described above, was accompanied by a study of the forces of crystallisation. Unfortunately it will not be possible to give a full account of these experiments here.

Of course much is known about crystallisation nowadays; still experiments above and below the surface of the soil, in order to study the influence of the different seasons, of the different depths, have—so far as I know—not yet been carried out. I began to study crystallisation in 1920, so I may look back over 20 years experience. A great variety of salts has been studied—salts which crystallise very quickly like sodium sulphate, and salts which need a long time to crystallise, like copper chloride.

Difference between day and night.

For those readers who are not well acquainted with this subject, a few introductory remarks will be of assistance.

What does “crystallise” mean? We find the word “crystallos” used in ancient times for what we call a “crystal” and for what we call “ice.” If we think about this fact, it is very good to combine the thought of crystallisation with the formation of ice. Here we see, in nature, the transformation of something liquid into the solid state. This transformation can take place, so that big masses of ice in rocklike formations appear; or the very subtle ice flowers, which decorate the windows in winter time. Quickly they appear and as quickly they disappear again. A good position for observing ice flowers is in a railway coach near the engine in winter time. The train stops; the hot vapour of the engine passes the windows; the train begins to move, cold air passes and immediately flowers begin to spread all over the window panes. Beautiful fernlike or palm-leaf-like formations are quickly drawn. At the next station, when again the hot vapour from the engine passes over the windows, the ice-flowers disappear as quickly as they were formed.

To crystallise means that “out of a liquid something solidifies.” The Primary Phenomenon of crystallisation is represented in ice, where water itself solidifies.

If water crystallises we find another remarkable thing. It is a law in nature, that warmth expands matter, and cold contracts it. If a piece of metal is heated, and measurements are taken before and after, we find an increase in volume; if the metal is cooled down again, it has contracted. If water becomes solid, it makes the opposite movement; water expands in freezing. This is very well known because in winter-time bottles containing liquids may burst if the liquid turns into ice.

In order to study this process of crystallisation, some salt may be dissolved in water. This process of dissolving also interferes with the temperature. Let us take some salt which dissolves very quickly, and in a large quantity. Feeling the water before and afterwards reveals that the temperature goes down considerably. The process of dissolving needs warmth, so the liquid cools down. Common use is made of this law. In winter-time, to get rid of ice, salt is sprinkled on it, and after a short time, the ice dissolves. The salt is stronger than the ice. The salt wants to dissolve itself, and in doing so reduces the ice to water. The temperature can be many degrees below zero, still the water remains liquid because of its salt content. This can quite easily be demonstrated by dissolving sodium nitrate in water. The temperature may go down to -14°C . Now we take a test tube; fill it with fresh water, and dip it in the water containing sodium nitrate; immediately the water in the test tube turns into ice.

The process of crystallisation is connected with changes in temperature. If out of a liquid something solid is deposited, something has also happened to the temperature. Therefore in studying crystallisation, all the changes in temperature have to be watched carefully.

A certain amount of salt may be dissolved in cold water. If the water is heated, more salt can be dissolved* until the point is reached where the water cannot go on dissolving it. If still more salt is added it falls down as a deposit. The solution is then said to be saturated. This saturated salt solution is poured into shallow glass dishes. The solution cools. The salt cannot stay dissolved, because there is no longer the necessary warmth; and we can watch how crystallisation begins. If the salt solution cools **slowly**, the process of crystallisation is also slow, the tiny crystal begins to grow, and develops slowly into a bigger one.

If the salt solution is cooled **quickly**, the salt falls out quickly. We cannot watch the slow formation of a big crystal; we see a great many tiny crystals pouring down to the bottom of the glass dish in powder form.

The first factor we have to observe is **temperature**; the second is **time**. The third is **concentration**: how much salt has been dissolved in a certain amount of liquid.

* (with some exceptions).

One more factor we soon learn to observe, namely: the surroundings. Suppose the experiment is made with sodium sulphate, there is a hot saturated solution. The glass dish is carefully filled. The room is rather cool, so the crystallisation ought to start soon. You sit very quietly before the glass dish and wait. You wait a quarter of an hour, half an hour, nothing has happened; one hour goes by; nothing has happened. At last you lose your patience and get up, moving the chair. In that moment in a fraction of a second your salt solution turns into solid matter. What has happened? You kept perfectly quiet for an hour. The solution cooled slowly, undisturbed and reached the state of "undercooling." Just because it was so perfectly quiet in the room, the salt remained dissolved even at much too low a temperature. You pushed back the chair, the immense tension which was in the saturated salt solution is broken, and the liquid turns into salt. There is no time for forming a beautiful crystal, not even time to form the hundred thousand tiny ones. If you are lucky you may find in your glass dish one beautiful starlike formation. Fig. 26 and 27 represent this phenomenon of slow and quick crystallisation. The forms we obtain in such experiments remind us very much of the way ice flowers form in winter time.

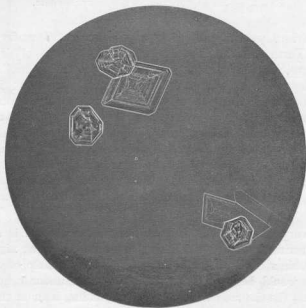


FIG. 26.—*Slow Crystallisation of Sodium Sulphate.*

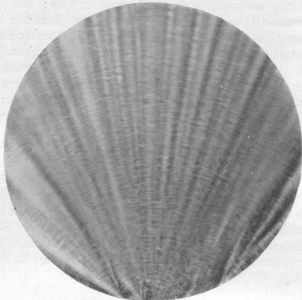


FIG. 27.—Quick Crystallisation of Sodium Sulphate.

In my previous publications about crystallisation* I made a distinction between the "Form of Crystallisation" and the "Force of Crystallisation." The "form" appears during a more or less slow process. The "form" of the single crystal shows to which crystallographic system it belongs; if it is a hexagonal, rhombic or monocline etc. crystal. But behind the appearance of the specific form, there is the "force" which brings about every kind of crystallisation. One watches the action of this "force" which shoots through the solution as the arrow flies from the bow, if such a sudden formation occurs. Looking at the single crystal one may be able to say immediately what substance has been used. Looking at a quick crystallisation one is often unable to say which salt has been used. It may be sodium sulphate; it could equally well be acetate of lead.

We were very interested in the question whether there is **any difference between an experiment carried out during day time or during night time**. We studied this problem from various angles, also with the help of crystallisation. One possibility would be to repeat the experiments under exactly the same conditions during the day and during the corresponding hour in the night. The **concentration** of the solution; the **temperature** in the room; and of course also the **humidity** of the air must all be the same. All these conditions can be carefully arranged. The day experiment is begun at noon exactly; note is taken

* Mitteilungen des Biologischen Instituts am Goetheanum No. 1, 2, 3, 4, (Records of the Biological Institute at the Goetheanum in Stuttgart, Württemberg), 1935.

of the temperature and humidity : the beginning of the crystallisation is watched ; the first tiny crystal forms after 15 minutes. The time when the crystallisation begins varies, of course, according to the salt, and according to the temperature and humidity in the room. The experiment is repeated at midnight, under exactly the same conditions. Nothing is changed except that the first experiment lasted from noon until midnight, and the other one started at midnight and ended at noon the next day. Then we compare : (1) the **size** of the crystals, whether both are alike, or whether one experiment has produced larger or smaller crystals than the other. (2) we may compare the **time** when the process of crystallisation started ; and finally (3) we may compare the **weight**. How much of the salt contained in the solution has solidified ?

Such experiments have been carried out for many years each noon and each midnight with different salts: sulphate of iron, alum, sulphate of copper, and nitrate of lead. There is a difference between the crystallisation carried out during the night or during the day. Summarising the result briefly we may say : **during night the beginning of crystallisation is quickened and the amount of salt which crystallises is increased.**

Of course we cannot limit ourselves to the study of noon and midnight changes.

One experiment may be started at 6 o'clock in the morning, and the other at the corresponding hour at night. But here a new problem has to be faced. What is the corresponding hour to 6 o'clock in the morning ? Is it 6 o'clock in the evening ? This question does not arise if one chooses noon and midnight. It is obvious that these two hours correspond. They are fixed by the sun. Either the sun has reached its highest point above the horizon, or the lowest beneath the horizon. Suppose we make our experiment in summer. The sun rises at 4 o'clock and sets at 8 o'clock. If we start the experiment at 6 in the morning, the sun has risen two hours before ; and in the evening the sun has not yet set. It is two hours before sunset. Are these really the corresponding times ? In the morning the sun has been 2 hours above the horizon, in the evening the sun is still 2 hours above the horizon.

Suppose we make the experiment in winter. The sun rises at 8 o'clock and sets at 4 o'clock. That means our experiment starts 2 hours before sunrise and two hours after sunset.

Let us try 10 o'clock in the morning and 10 o'clock in the evening. In summer it may mean 6 hours after sunrise and 2 hours after sunset. In winter it may mean 2 hours after sunrise and 6 hours after sunset. Is it reasonable to compare these experiments ? Have we really the corresponding hours during the night ? No. We cannot look at the clock and compare 10 with 10, or 3 with 3 ; they mean something different in the course of the year. We must look to the cosmos, to the position of the sun. Night begins when the sun sets ; and day starts when the sun rises. We must compare the position of the sun below

and above the horizon. When the sun is three hours above the horizon, the corresponding time will be, when the sun is 3 hours below the horizon. In Summer our clock will show that it is 7 in the morning and 23 in the evening. Or 8 in the morning (4 hours after sunrise) corresponds with midnight (4 hours after sunset). If we start to count from sunrise to sunset, we suddenly find that 8 o'clock in the morning has to be compared with midnight. Noon in summer means 8 hours after sunrise, and has its counterpart 8 hours after sunset; there we arrive again at sunrise. So we see it is not easy to find the real, corresponding hour. During the equinox when day and night are equal, there is no difficulty. Sunrise and sunset correspond; midnight and noon; 3 hours after sunrise (9 o'clock) correspond to 3 hours after sunset (9 o'clock) 4 hours after sunrise (10 o'clock) correspond to 4 hours after sunset (22 o'clock) and so on. But in summer we have 16 day hours to 8 night hours; and in winter we have 16 night hours to compare with 8 day hours.

The only solution to this problem is to have both in summer and winter, 12 hours of daytime, and 12 hours of night time. The old Chaldeans had this time measure. They divided the time between sunset and sunrise into 12 parts and the time between sunrise and sunset again into 12. Using this method we keep the 24 hours for the day—only the **hours have a different length. In summer we have long day-hours and short night hours, in winter we have short day hours and long night hours.**

This is again a very **natural** thing to do. Do we not feel in winter that the night is endlessly long; the hours drag so slowly? And how quickly the day goes by! We can never finish all we have to do! In Summer, how soon the night is over; the hours run away so fast. We must learn a very important thing—to recognize the **quality of each hour.**

Let us take the sunrise again at 4 in the morning, and the sunset at 8 in the evening; that makes 16 hours, each having 60 minutes, or **12 hours each having 80 minutes.** The night has 8 hours, each with 60 minutes, or **12 hours, each having only 40 minutes.** In winter the opposite takes place, the night hours have 80 minutes and the day hours only 40.

The study of plant growth has forced us to introduce the "natural year"; the study of crystallisation, the necessity to find the real, corresponding hour during the night, forces us to **create the introduction of the "natural hour".**

It is not comfortable; you cannot experiment automatically each day at the same hour; you have to reckon out every day the exact time according to the real sunrise and sunset. During the equinox we have day and night at equal length, also each hour has the same length of 60 minutes; but the length of the hour varies according to the length of the day, and the length of the day varies according to the position of the sun to the earth.

The following sketches illustrate what is meant by the "natural hour." The first sketch (Fig. 28) shows the picture we get during the equinox; each hour has the same length of 60 minutes; day and night have the same length of 12 hours.

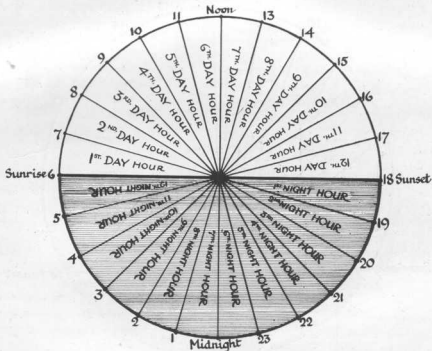


Fig. 28.

The second sketch (Fig. 29) illustrates what happens in summer, if we try to oppose the first hour of the day with the first hour of the night ; 8 hours are left over during day time. We have no night hours to oppose.

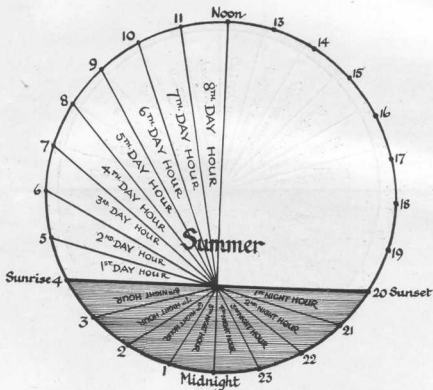


Fig. 29.

The fourth sketch (Fig. 31) illustrates the longer hours in summer-time during the day and the shorter hours during the night ; but we get 12 hours for the day and 12 for the night. The first hour during the day lasts from 4 to 5.20 and the first hour during the night lasts from 20 to 20.40.

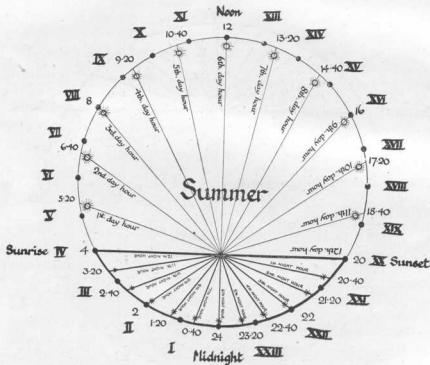


Fig. 31.

The fifth sketch (Fig. 32) illustrates, during winter, the short day hours and the long night hours. The first day hour lasts from 8 to 8.40 and corresponds to the first night hour which lasts from 16 to 17.20.

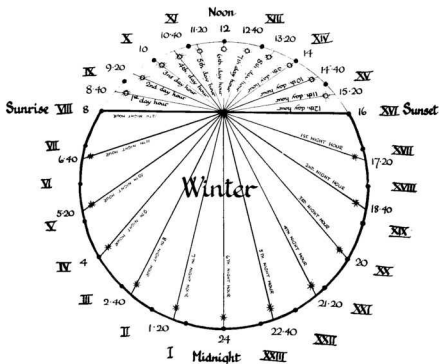


Fig. 32.

Of course these sketches change again and again according to the changes in sunrise and sunset. But that also means the real times may be compared in an exact experiment, if we want to study the changes which happen, hour after hour, according to summer and winter, spring and autumn.

These experiments have been carried out for years, to compare the crystallisation of at least four different metal salts during day time and at the corresponding hour during the night, with the help of the "natural hour" system. If one does this for years, it is astonishing what a new sensitiveness for "time" one acquires. One begins to be aware of the different quality each hour has during day or night in summer or in winter.

Another way to study crystallisation is to go on incessantly each hour, every day and night, and then to compare the results of the "conventional hours" with the result of the "natural hours."

All these experiments have been carried out. The results are, as I summarised briefly before: during the night crystallisation begins more quickly, and the weight is greater. It is impossible to go into details here.

Still these experiments are not quite satisfying. One part of the experiment is **artificial**. Can we really say that we study the influence of day and night and the different seasons, if we establish an artificial temperature and humidity? The natural difference of day and night consists also in a change of temperature and humidity, and the difference of Summer and Winter necessarily has these small daily differences in a much higher degree. **If we want to follow up the steps nature performs, we cannot create artificial conditions in the laboratory.**

How can we find the difference between crystallisation in Winter and Summer, if we make them in a room which is kept, Summer and Winter, at the same temperature? We create an artificial summer during winter and we find that we have some more experiments to carry out. The one part has to be done in the laboratory the other part in the open. One series of experiments stood every day in summer and winter outside the laboratory on the windowsill, and another one on the surface of the soil in the garden in a quiet spot.

In a cold winter it happens that not only salt crystals are formed, but the rest of the solution is also frozen. There is one exception: Sulphate of iron, sulphate of copper and alum may freeze, but even during very cold winters, nitrate of lead did not freeze. These experiments in the open, may be compared with all the others carried out under artificial conditions in the laboratory.

Again we may doubt whether we are getting the right result, considering how much crystallisation is influenced by changes in temperature, if we submit our experiments to such big changes and even to the chance of freezing. The conditions are "natural" but we know everything that can be said against them. Where can we find "**natural conditions**," which are stable summer and winter, the whole year round, so that we can say the changes are not due partly to the influence of temperature?

Beneath the surface of the soil ! If we look at our temperature chart some metres below the surface of the soil, we find nearly no change in temperature summer and winter, or only a very slight one. It is quiet ; it is always dark ; we have the same humidity, and only natural conditions.

For one year every day crystallisation was started at the same time inside the laboratory, outside the window, on the surface of the soil, and 1—16 metres deep, below the surface.

Each day fresh solutions had to be prepared, containing always the same concentration of sulphate of iron, sulphate of copper, alum, and nitrate of lead. These solutions were put in thermos flasks and poured into the glass dishes with a measuring glass, so that always the same amount of solution was used. Of course this had to be done below the surface of the soil, on the spot where the crystallisation had to take place. The next day one series of glass dishes containing the finished crystallisation came up and the fresh experiments started. The finished crystallisations came into the laboratory, the remaining liquid was put away, the crystals carefully lifted out of the glass dish, put on filter paper to dry, then each experiment was weighed.

60 glass dishes were placed below the surface.

4 on the surface of the soil.

4 outside the window.

4 in the laboratory.

72 crystallisations each day.

After the weight had been recorded, the crystals were laid out on black paper and photographed.

In following years the experiments were carried out on alternative days.

Meanwhile other experiments were made, dealing with crystallisation with chloride of quicksilver and many other salts. Only the 4 above mentioned salts were used uninterruptedly.

As already mentioned it is impossible to give a full account here of these numerous experiments ($72 \times 365 = 26,280$ a year). It is only possible to give a few examples and then to summarise the result. Figs. 33 A and B represent the photograph of one such experiment in January, 1932.

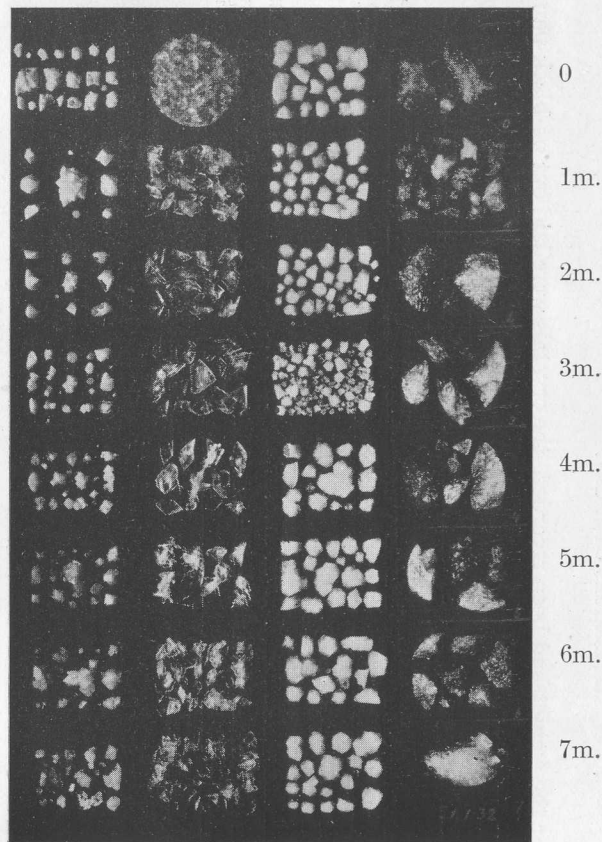


FIG. 33A.

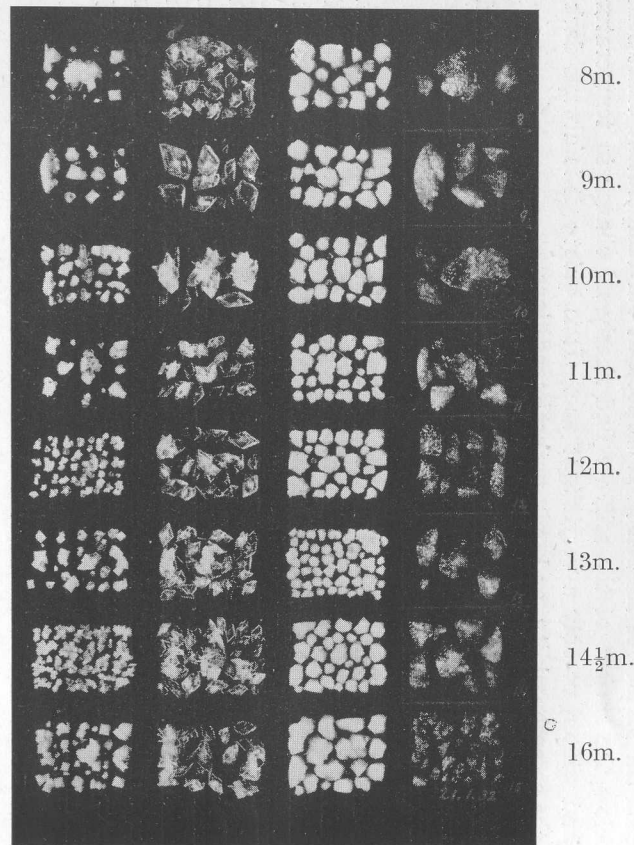


FIG. 33B.

Crystallisation carried out January 21st, 1932, with Nitrate of Lead, Sulphate of Copper, Alum and Sulphate of Iron.

It is seen that the crystals in the first column vary in size, and apparently also in quantity, according to the different depths of the soil. Each square contains the crystals of one experiment ; the first square on the top left side represents nitrate of lead at the surface of the soil ; underneath, nitrate of lead crystallised one metre below the surface of the soil, underneath again, crystallised 2 metres below the surface and so on. In the second column we find the crystals of copper sulphate ; in the third, crystals of alum ; and in the fourth, the crystals of iron sulphate. The actual figures of the actual quantities are :

	Lead nitrate	Copper sulphate	Alum	Iron sulphate
Grams	6.3 = Surface	6.1 = Surface	7.8 = Surface	6.5 = Surface
"	7.9 = 1 m.	6.7 = 1 m.	5.3 = 1 m.	7.9 = 1 m.
"	5.8 = 2 m.	5.0 = 2 m.	5.2 = 2 m.	5.8 = 2 m.
"	4.3 = 3 m.	6.2 = 3 m.	4.8 = 3 m.	7.3 = 3 m.
"	4.2 = 4 m.	4.4 = 4 m.	5.2 = 4 m.	7.2 = 4 m.
"	5.0 = 5 m.	4.7 = 5 m.	7.5 = 5 m.	6.5 = 5 m.
"	5.5 = 6 m.	5.5 = 6 m.	6.1 = 6 m.	7.5 = 6 m.
"	4.2 = 7 m.	5.2 = 7 m.	7.2 = 7 m.	5.5 = 7 m.
"	4.8 = 8 m.	4.8 = 8 m.	6.2 = 8 m.	4.8 = 8 m.
"	4.3 = 9 m.	4.8 = 9 m.	6.2 = 9 m.	7.3 = 9 m.
"	4.2 = 10 m.	6.2 = 10 m.	8.0 = 10 m.	6.2 = 10 m.
"	4.0 = 11 m.	3.1 = 11 m.	5.1 = 11 m.	7.8 = 11 m.
"	3.9 = 12 m.	4.9 = 12 m.	5.8 = 12 m.	7.6 = 12 m.
"	4.3 = 13 m.	4.5 = 13 m.	4.7 = 13 m.	6.3 = 13 m.
"	6.0 = 14½ m.	5.2 = 14½ m.	7.4 = 14½ m.	7.4 = 14½ m.
"	6.4 = 16 m.	5.5 = 16 m.	9.0 = 16 m.	6.4 = 16 m.

Another experiment about a month later is represented in Fig. 34 A and B.

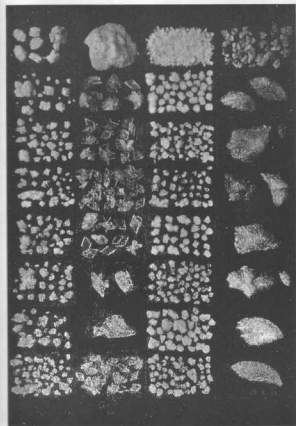
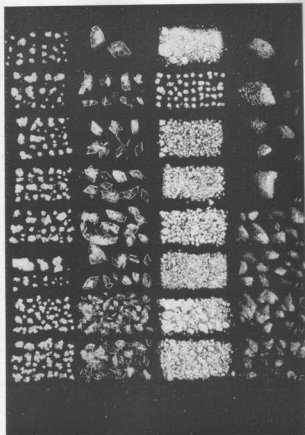


FIG. 34A.

0
1m.
2m.
3m.
4m.
5m.
6m.
7m.



8m.
9m.
10m.
11m.
12m.
13m.
14½m.
16m.

FIG. 34B.

Crystallisation carried out February 13th, 1932.

If we compare these two months as represented by these two photographs, we notice that a greater amount of nitrate of lead has crystallised on the surface of the soil in February, than in January ; the same has happened with sulphate of copper. We can even notice that the copper has frozen, forming nearly one solid block. The single crystals disappear in that formless cluster. Alum is more pulverised ; and with regard to the iron sulphate we are not even able to spread out the full amount of crystallised salt in the tiny square allotted to each salt.

Copper sulphate has partly formed beautiful, clear crystals.

Alum varies between more or less pulverised crystallisations, according to the various depths.

Sulphate of iron forms huge clusters of beautiful crystals, then decreases ; and between 12 to 16 metres the crystals become considerably smaller. The amount of salt crystallised, expressed in grams, is the following :

	Lead nitrate	Copper sulphate	Alum	Iron sulphate
Grams	12.4 = Surface	10.5 = Surface	8.5 = Surface	14.7 = Surface
..	7.9 = 1 m.	6.2 = 1 m.	8.5 = 1 m.	7.9 = 1 m.
..	8.4 = 2 m.	5.7 = 2 m.	6.8 = 2 m.	8.2 = 2 m.
..	7.2 = 3 m.	6.2 = 3 m.	5.0 = 3 m.	7.7 = 3 m.
..	6.5 = 4 m.	4.6 = 4 m.	7.1 = 4 m.	6.3 = 4 m.
..	7.2 = 5 m.	4.2 = 5 m.	6.5 = 5 m.	6.3 = 5 m.
..	5.6 = 6 m.	3.3 = 6 m.	7.5 = 6 m.	5.8 = 6 m.
..	4.4 = 7 m.	5.4 = 7 m.	7.2 = 7 m.	5.1 = 7 m.
..	3.6 = 8 m.	3.6 = 8 m.	5.6 = 8 m.	4.1 = 8 m.
..	5.2 = 9 m.	4.1 = 9 m.	5.0 = 9 m.	6.1 = 9 m.
..	5.1 = 10 m.	5.0 = 10 m.	6.7 = 10 m.	6.4 = 10 m.
..	3.8 = 11 m.	5.5 = 11 m.	3.5 = 11 m.	5.1 = 11 m.
..	4.6 = 12 m.	6.8 = 12 m.	4.6 = 12 m.	9.4 = 12 m.
..	3.8 = 13 m.	5.9 = 13 m.	4.1 = 13 m.	10.5 = 13 m.
..	6.2 = 14½ m.	6.9 = 14½ m.	5.9 = 14½ m.	13.5 = 14½ m.
..	7.5 = 16 m.	7.2 = 16 m.	6.2 = 16 m.	12.2 = 16 m.

Now we return to the photograph and find the interesting fact that **quality** and **quantity do not coincide**. The beautifully shaped, and clear, transparent crystals of copper sulphate 6 metres below the surface of the soil, represent only, 3.3 grams of salt ; whereas the less beautifully shaped tiny crystals at 14½ metres below the surface represent 6.9 grams of salt.

We find the same phenomenon in looking up the crystallisation of iron sulphate. The big crystal at 4 metres below the surface has a weight of 6.3 grams ; and the smaller crystals at 14½ metres represent 13.5 grams. Beautifully shaped crystals are nearly always less heavy. We must say that beauty is a certain quality in

crystallisation. We may perhaps prefer a beautifully shaped crystal to a less beautifully shaped one. Then we have less material. If we want the bigger quantity than we get less beauty.

Quality and quantity differ in every field of life. In plant life we find the difference expressed in a huge cabbage which looks marvellous—but if we look for the quality, it has not so much nutritive value as a smaller one. But we will refer to this in another chapter of this book.

Between January and February we note that the crystallisation increases in weight. I am sorry that I cannot include in this book more of this interesting material. I have to limit myself to only a few examples. Fig. 35 A and B represents the photograph of an experiment carried out in the month of July, and Fig. 36 A and B another one carried out in the month of August.

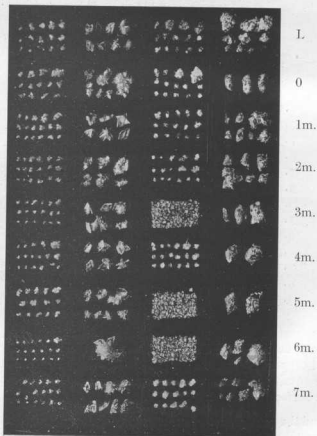


FIG. 35A.

Crystallisation carried out during July 11th, 1932.

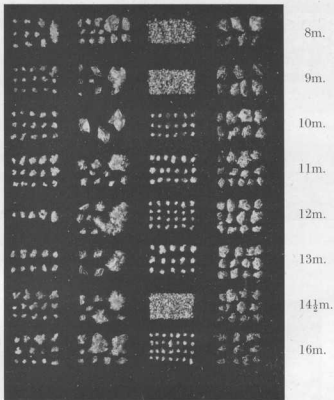


FIG. 35B.

Crystallisation carried out during July 11th, 1932.

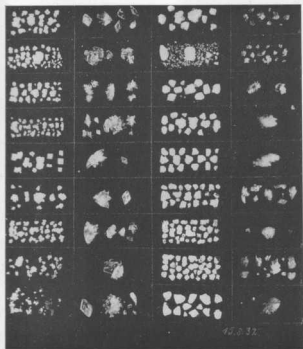


FIG. 36A.

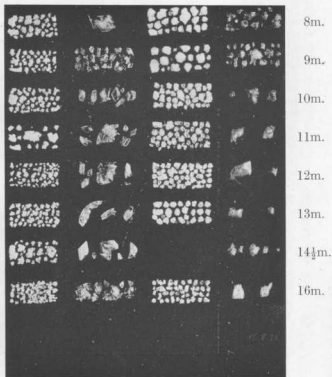


FIG. 36B.

Crystallisation carried out during August 15th, 1932.

We see immediately that the quantity is considerably smaller in July and August than in January and February. The actual figures for the weight of these two experiments are given below :

	Lead nitrate	Copper sulphate	Alum	Iron sulphate
Grams	4.4 = Lab.	4.5 = Lab.	3.2 = Lab.	5.6 = Lab.
"	4.2 = Surface	4.2 = Surface	3.4 = Surface	4.6 = Surface
"	3.7 = 1 m.	4.3 = 1 m.	3.1 = 1 m.	6.3 = 1 m.
"	2.8 = 2 m.	4.1 = 2 m.	2.9 = 2 m.	5.2 = 2 m.
"	2.4 = 3 m.	4.6 = 3 m.	2.7 = 3 m.	4.1 = 3 m.
"	3.1 = 4 m.	3.9 = 4 m.	2.6 = 4 m.	4.2 = 4 m.
"	2.3 = 5 m.	3.4 = 5 m.	3.4 = 5 m.	4.9 = 5 m.
"	2.1 = 6 m.	3.2 = 6 m.	4.5 = 6 m.	4.0 = 6 m.
"	2.1 = 7 m.	4.1 = 7 m.	4.8 = 7 m.	3.2 = 7 m.
"	2.4 = 8 m.	3.8 = 8 m.	4.7 = 8 m.	5.1 = 8 m.
"	2.8 = 9 m.	3.4 = 9 m.	4.9 = 9 m.	6.1 = 9 m.
"	3.1 = 10 m.	3.7 = 10 m.	3.5 = 10 m.	5.4 = 10 m.
"	3.4 = 11 m.	3.3 = 11 m.	3.8 = 11 m.	5.8 = 11 m.
"	1.1 = 12 m.	4.1 = 12 m.	3.3 = 12 m.	5.7 = 12 m.
"	2.3 = 13 m.	2.9 = 13 m.	3.5 = 13 m.	5.3 = 13 m.
"	3.2 = 14½ m.	3.8 = 14½ m.	4.1 = 14½ m.	5.0 = 14½ m.
"	3.2 = 16 m.	4.6 = 16 m.	4.3 = 16 m.	4.8 = 16 m.

Weight of the crystals on July 11th, 1932.

	Lead nitrate	Copper sulphate	Alum	Iron sulphate
Grams	5.5 = Lab.	4.0 = Lab.	4.0 = Lab.	1.7 = Lab.
"	4.2 = Surface	3.8 = Surface	3.3 = Surface	1.0 = Surface
"	4.0 = 1 m.	2.5 = 1 m.	3.5 = 1 m.	1.4 = 1 m.
"	2.9 = 2 m.	3.3 = 2 m.	3.2 = 2 m.	2.3 = 2 m.
"	3.6 = 3 m.	3.3 = 3 m.	4.5 = 3 m.	2.2 = 3 m.
"	3.9 = 4 m.	3.2 = 4 m.	4.5 = 4 m.	2.5 = 4 m.
"	3.8 = 5 m.	3.4 = 5 m.	3.5 = 5 m.	2.0 = 5 m.
"	3.5 = 6 m.	2.6 = 6 m.	3.8 = 6 m.	3.0 = 6 m.
"	2.8 = 7 m.	3.8 = 7 m.	4.8 = 7 m.	3.2 = 7 m.
"	4.7 = 8 m.	2.3 = 8 m.	4.6 = 8 m.	2.7 = 8 m.
"	2.3 = 9 m.	3.0 = 9 m.	3.6 = 9 m.	2.1 = 9 m.
"	3.7 = 10 m.	2.5 = 10 m.	4.7 = 10 m.	1.7 = 10 m.
"	3.3 = 11 m.	2.5 = 11 m.	4.8 = 11 m.	1.9 = 11 m.
"	3.9 = 12 m.	3.7 = 12 m.	4.9 = 12 m.	2.5 = 12 m.
"	3.4 = 13 m.	3.3 = 13 m.	3.9 = 13 m.	1.7 = 13 m.
"	3.1 = 14½ m.	3.5 = 14½ m.	0.0 = 14½ m.	1.1 = 14½ m.
"	4.2 = 16 m.	4.2 = 16 m.	3.4 = 16 m.	1.6 = 16 m.

Weight of the experiment carried out 15th August, 1932.

The comparison between the weight in the month of February and August proves that there is an immense difference between the forces of crystallisation in nature during Summer and Winter. For iron we get in February, $14\frac{1}{2}$ metres below the surface, 15 grams ; in August only 1 gram. Of course it would be impossible to pass such a judgment in looking only at the few examples which we are able to reproduce here. But in referring to the statistics of many years, we are able to say that there is a certain period during the course of the year in which the forces of crystallisation are stronger, and another period where these forces are less strong. A few charts follow here to elucidate this assertion :

Average weight during the 12 months 1930 :

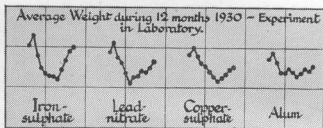


FIG. 37.—Experiments carried out every day in the laboratory.

The strongest effect is produced by the iron salt. Maximum weight in the month of February 13.0 grams, minimum weight between June and August = 2 grams.

Lead nitrate produced the greatest effect in the month of February with a maximum weight of 11 grams ; minimum weight in the month of June = 1 gram.

Sulphate of Copper produced the greatest effect in the month of February with a maximum weight of 10 grams ; minimum weight in the month of August with 1.5 grams.

Alum produced the greatest effect in the month of February with a maximum weight of 9 grams ; minimum weight in the month of August with 3 grams.

Average weight during the 12 months 1930 :

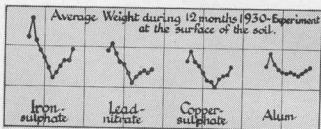


FIG. 38.—Experiments carried out on the surface of the soil.

Iron sulphate : maximum weight in the month of February with 17 grams ; minimum weight in the month of July with 2 grams.

Lead nitrate : maximum weight in the month of February with 11 grams ; minimum in the month of July with 1 gram.

Copper sulphate : maximum weight in the month of February with 9 grams ; minimum weight in the month of August with 0.5 grams.

Alum : maximum weight in the month of February with 8 grams ; minimum weight in the month of September with 3 grams.

Average weight during the 12 months of 1930 :

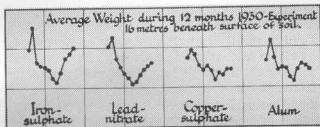


FIG. 39.—Experiments carried out 16 metres below the surface.

Iron sulphate : maximum weight during the month of February with 15 grams ; minimum weight during the month of August with 2 grams.

Lead Nitrate : Maximum weight during the month of February with 13 grams ; minimum weight during the month of July with 0.8 gram.

Copper sulphate : Maximum weight during the month of February with 10 grams ; minimum weight during the month of August with 1.8 grams.

Alum : maximum weight during the month of February with 12 grams ; minimum weight during the month of August with 1.5 grams.

If we compare the different years there are of course variations according to the particular character of the year. Sometimes the maximum weight reached for Iron sulphate is as much as 19 grams ; sometimes the maximum is only 15 grams. The minimum may be as low as 0.5 grams ; sometimes as high as 3 grams. But we always find that the **maximum of the crystallising forces is between January and February** ; between June and August the crystals have scarcely any weight. They may look beautifully clear, the forms may be perfect ; even lead, which is ordinarily more or less opaque, may become translucent, but there is no weight in the crystals ; it is as if they are formed out of air.

Sometimes strange things happen. Why should we refrain from mentioning them ? They were witnessed by my collaborators—but we were unable to take a photograph. Usually it is iron sulphate which may produce this strange phenomenon in Summer. There is no crystallisation at all—and yet you see the crystal. But it is only a shadow-crystal. We do not know if any body else has ever observed this phenomenon. If you take the glass dish very carefully from the place where

it has been for 24 hours, some metres below the surface of the soil (sometimes it may even be very close to the surface), then you observe at the bottom of the glass dish a thin layer of sediment, and in this sediment the perfect shape of one or more rhombic crystals; only it is an **empty form outlined** in the sediment; the ghost of a crystal. We never succeeded in getting it unharmed into the laboratory. It is not possible to move the glass dish without shaking it, and the slightest movement that takes place in the liquid dissolves that shadow-crystal.

There is no other explanation to be found, than that the **forces which would have been able to form the crystal went through the solution, but the material was not ready to enter the form.**

On a higher level in nature you may observe a similar phenomenon, that a form may be built up, but **life** does not enter. In the mineral kingdom you may find the force working, but the material is not ready to use the form. This is a very strange but highly interesting phenomenon, which we sometimes find, and which enables us to look more closely into the inner being of nature, and fills our souls with reverence.

We must try to understand these two forces in nature: the force of crystallisation and the force of vegetation. Our experiments with wheat plants carried out for the purpose of studying the influence of the moon, show that maximum growth appears between June, July and August. That is just the period when the forces of crystallisation are at their minimum. When the plants are growing and growing, matter cannot contract and form heavy crystals.

We may compare the process of growth with the process of crystallisation by exchanging these words for two others: "**expansion**" and "**contraction.**" These are similar polarities. Matter consolidates itself out of the liquid state; it falls out in large quantities and very quickly; it has not the time to form beautiful crystals which slowly ripen to their perfection, just during that time of the year—January to February—when the plants are resting, when the seeds are waiting in the soil for the Spring. When the forces of vegetation withdraw, then crystallisation is at its culminating point. Even the water is overpowered by its strength and turns into solid ice; ice flowers quickly form on the windows; snow stars fall from heaven and cover the soil with a white blanket; and underneath the seeds are waiting. The vegetation is at its lowest point. Is it not wonderful to understand how nature works with such immense wisdom; how the forces are distributed in the Universe?

Every farmer and gardener should understand these forces because he has to deal with nature for the welfare of mankind. He has to know the inner qualities of Summer and Winter; of Sun and Moon and Stars, and how they enter into plant life, changing the quantity and quality of his crops. A severe winter breaks up the soil differently from a mild one; and in a different strength the soil answers later on to the forces of vegetation. You cannot really grow food for mankind, if you only follow automatically the advice of the chemist, and sprinkle the soil with fertilizer. Never can any artificial fertilizer replace nature's work.

PLANETARY INFLUENCES UPON CRYSTALLISATION.

Here I can merely mention the fact that there is a possibility of studying the planetary influences upon crystallisation. A detailed account of this will follow in the book "The Seven Planets and the Seven Metals" which I hope to be able to publish one day. But having dealt with this great rhythm of Winter and Summer, the two streams of the forces of Vegetation and Crystallisation, I cannot omit to point out that the influences of the different planets are interwoven in this great yearly rhythm. If we carry out experiments with salt solutions like Lead nitrate, or Copper sulphate, or Iron sulphate, day after day for a year, we learn to know the **big rhythm of the Year**.

The experiments carried out **hour after hour day and night**, reveal the **smaller rhythm of day and night**, which is interwoven in the bigger one of Summer and Winter.

In this smaller rhythm of day and night, we find again interwoven the **interference of the planetary influences**. Here is just one example.

We take a certain concentration of Lead nitrate and, after our long experience, we know that this solution, containing so much lead salt, takes in the month of June, between 10 and 12 in the morning, about 12 to 13 minutes to start crystallisation. After two hours of crystallising we may expect a certain amount of crystallised salt. We know these figures exactly, because the same experiment has been carried out hour after hour during the whole month. We also know, with the same certainty, the figures and times we have to expect in the case of other metal salts used at the same time. Suppose there is a conjunction of the planet Saturn with the Moon at mid-day—then we have to expect an interference in the usual course of the crystallising process.

The experiments are carried out as usual every hour, but when the time of the conjunction draws near we add more control dishes, and repeat the experiments at intervals of $\frac{1}{2}$ hour; and in the last half hour before the conjunction a fresh experiment is started every 5 minutes. After the conjunction we still go on with the experiments every 5 minutes. Then $\frac{1}{2}$ hour later we increase the interval again to $\frac{1}{2}$ hour between each experiment, until we see that the normal conditions are restored.

The effects of a conjunction between Saturn and Moon are only to be found in the solution containing lead. Copper and Iron salts are not affected.

The **conjunction nearly always delays the beginning of the crystallisation; sometimes it may even happen that no crystallisation at all takes place**. The amount of salt which is deposited is greatly reduced.

It is not advisable for the study of planetary influences (conjunctions or oppositions) to prepare the solution in advance and then only pour it into the dishes for crystallising. It is important to dissolve the salt at the exact times and then put it into the glass dish for the crystallisation. A careful observation will show, that the salt also **takes a different length of time for the dissolving process during a conjunction or opposition**.

OTHER PLANETARY INFLUENCES ON PLANTS.

Having explained the influence of the moon on plant growth, the question arises: how about the other planets? That the sun affects plant life nobody doubts, but if we find that the moon enters into the germination and growth process of the plants, why should it not also be possible to find an influence proceeding from Venus, Mercury, Mars, Jupiter or Saturn?

Once there was an ancient knowledge of the connection between plants and stars. This knowledge we have lost. We have to confess this in all honesty: we do not know to-day how, or even whether, the stars have anything to do with the different plants. It does not even help us very much to look into old books, for what we read there we cannot understand. It does not fit in with our scientific world conception. I remember vividly having a long talk with an English scientist who came to see the Biological Institute, and to discuss my publication about the "Influence of the Moon on Plant Growth." "Your experiments are very convincing. But if the moon has that influence, what about the other planets? Do you know Culpeper's Herbal? There must be something in it, I am quite sure. But I cannot understand it."

"Culpeper's * **Complete Herbal**, consisting of a comprehensive description of nearly all British and foreign herbs, with their medicinal properties, and directions for compounding the medicines extracted from them" is a very interesting book. It is not even a very old book. Culpeper has a certain system in his descriptions of the single plants:

1. Description: of the plant
2. Place: where the plant grows
3. Time: when the plant flowers and ripens
4. Government and virtues: to which planet the plant belongs, and what its specific qualities are.

We read in this book for instance, that Aconite is under the government of Saturn; or "Angelica is an herb of the Sun in Leo, let it be gathered when he is there, the Moon, applying to his good aspect; let it be gathered either in his hour, or in the hour of Jupiter: let Sol be angular: observe the like in gathering the herbs of other planets and you may happen to do wonders."

Or: "Kidneywort (Cotyledon Umbilicus), Government and Virtues: Venus challenges the herb under Libra."

"Oak Tree: Government and Virtues: Jupiter owns the tree."

"Maple Tree: Government and Virtues: is under the Dominion of Jupiter."

Culpeper not only tells under which planet the plant is placed, but also says that the herbs should be gathered at a certain constellation. But he does not fully explain what has to be done. The last chapters of the herbal are dedicated

* Nicholas Culpeper, born 1616.

to prescriptions for making syrups, etc. Chapter 1 : Of Leaves of Herbs or Trees, tells us under point 5 ; "such as are astrologers (and indeed none else are fit to make physicians) such I advise ; let the planet that governs the herb be angular, and the stronger the better, if they can in herbs of Saturn, let Saturn be in the Ascendant ; in the herbs of Mars, let Mars be in Midheaven ; for in those houses they delight ; let the Moon apply to them by good aspect and let her not be in the houses of her enemies. If you cannot well stay till she applies to them, let her apply to a planet of the same triplicity ; if you cannot wait that time either let her be with a fixed star of their nature."

To understand the herbal of Culpeper we must not only understand Botany and Medicine, we must also have a knowledge of Astronomy and Astrology.

If we take instead of Culpeper's Herbal an up-to-date modern book about medicinal herbs, we will of course also find the description of the specific plants ; then we are told where the plants grow, and which is the best time to collect them. Sometimes we are told how these plants have been used in antiquity or in the Middle Ages, with historical notes reaching as far back as the 1st century B.C.

We may even be told about the different use in allopathic or homoeopathic medicine. But we are not told about the planetary forces which rule and govern the plants, or how the position of the planets must be considered for the purpose of gathering and drying them. Instead of this, something new is introduced in the modern herbals : the **science of Chemistry**. We are told the chemical constituents. Sometimes we get quite a long list of complicated names and formulae. It seems that Astronomy has been exchanged for Chemistry. But are we really the wiser for it ?

An attempt to solve some of these problems :

It can be proved with many experiments, demonstrated in the previous chapters, that the moon influences plant growth. Nobody doubts the influence of the sun. Is there any possibility of proving that other planets also influence plant life ?

We started experiments in this direction with the **Sunflower** (*Helianthus annuus*) 1928. Why is this flower called Sunflower ? It was introduced probably from Mexico in about 1569, and Linnaeus formed the name from the Greek "helios" = Sun, and "anthos" = flower, comparing the huge yellow flowers and their radiating petals with the Sun. The flowers always turn their "heads" in the direction of the sun. So we are told ; and it seems to be more or less an external point of view, it was the form of the flower, which made Linnaeus choose the name.

Rudolf **Steiner** mentioned in his lectures for farmers and gardeners how the cosmic forces of the sun are supported by the various planetary forces of Jupiter, Mars, Saturn, and that we may see some of these forces in the **colour** of flowers. For instance in the **red** rose, we see the forces of the planet **Mars** : in **blue** flowers

the force of **Saturn** ; and in **white** and **yellow** flowers the forces of the planet **Jupiter**. He even mentioned the sunflower, saying that the name is not quite correctly chosen. According to the colour this plant should be called a **Jupiter flower**.

These statements of Rudolf Steiner gave me a certain cue for the starting of my experiments. Of course I knew that these experiments would take years to produce any reliable result.

With the following simple account, we leave it to the reader to judge for himself the value of these experiments.

How may we discover if the sunflower is in connection with the planet Jupiter ? Jupiter is the giant of our planetary system and is easily recognised by its quiet and brilliant white light which outshines all other planets. Its volume is about 1300 times that of the earth. From ancient times the planet Jupiter has been related to the metal **Tin**. Jupiter or Zeus, the God who hurls the lightning flashes and lets the thunder speak, was held to be the god of the greatest among the planets ; the metal tin was also connected with him. In the Middle Ages without more ado, the name Jupiter was applied to tin, and his planetary sign given to the metal. This custom still obtained in much more recent times, but was supported only by tradition. It has already been mentioned in a previous chapter that experiments have been carried out for studying the planetary influences on metal salts. To-day we can prove with sufficient material that this influence exists. In 1932 we published a book " Jupiter and Tin " in which some of the material is reproduced. Tin and Jupiter are so to say, a unity. **Solutions of tin are susceptible to influences of the planet Jupiter**. If we take this as an established fact, we may proceed to the next step and ask the question : **has tin anything to do with the sunflower ?** Can we establish perhaps a proof, that the sunflower has a certain inclination for tin ?

With this question in our minds we started the first very simple experiment. The German biologist Professor Naegeli published in a scientific treatise about the oligodynamic effect of metals. That means metals are able to radiate certain forces in a liquid. A copper coin in a vessel containing water changes the quality of the water. Later on it was found out, that silver wire produced an effect harmful to bacteria, etc. Taking these well established scientific facts into consideration, I used specially made square dishes of various metals : lead, tin (pure Banka tin), iron, a thin sheet of pure gold, copper and silver. Quicksilver being in a liquid state had to be poured into a glass dish. The different metal dishes were filled with rain water (also poured on to the top of the quicksilver) and then seeds of the sunflower were inserted. The sunflower had been grown the previous year in our experimental garden. All the seeds used for this experiment were taken from the same sunflower. Each metal dish contained 20 seeds. They were all exposed to the same temperature and light. It was a very simple

experiment, but had to be carried out very carefully. We watched the beginning of the germination to see in which metal dish the seeds would germinate first.

After 24 hours germination started on the Tin

„ 48	„	„	„	„	Quicksilver
„ 60	„	„	„	„	Iron
„ 68	„	„	„	„	Copper
„ 96	„	„	„	„	Gold
„ 80	„	„	„	„	Silver
„ 75	„	„	„	„	Lead

That was an interesting beginning, that the sunflower seeds selected the tin dish in preference to all the others. It was rather surprising that the second best was quicksilver.

The second step was to treat sunflower seeds with different solutions of tin and quicksilver salts. We combined the experiment with our studies on the effect of Smallest Entities (see Part II "The introduction of 'Smallest Entities' into Agriculture") and prepared the solutions from the first up to the 60th potency. The third substance we tried was chloride of gold, also first to the 60th potency; and there were 100 control seeds treated only with rain water.

We obtained the following result: The usual effect of potentiising was observed: that the first potencies are smaller than the water control, then there is slowly increasing growth, and again decreasing growth. We reach the first minimum; then again growth increases to a maximum, and decreases to a second minimum, and so on. To be sure about our water control plants we begged permission to measure all the sunflowers growing in private gardens in the surroundings of the Biological Institute. The average growth we found in all the gardens was 2.65 m. Our own water control plants kept the same level. Maxima and Minima of the sunflowers growing under the influence of the potentised metal salt solutions differed enormously:

Water control plants average growth: 2.65 metres.

Minimum of the tin series: 1.38 metres

Maximum „ „ „ 3.65 „

Minimum of the quicksilver series: 1.15 metres

Maximum „ „ „ 3.56 „

Minimum of the gold series: 0.90 metres

Maximum „ „ „ 2.90 „

If we look only at the length of the plants, we must say that the plants treated with quicksilver produced nearly the same effect as those treated with tin. But if we look from the figures to the real plant we get a different impression. There is a great difference between the sunflowers treated with tin or with quicksilver. The tin sunflowers looked healthy and strong; they had thick stems which possessed a certain amount of flexibility. You may bend the stem and the flower

springs back. The quicksilver sunflowers however, reaching nearly the same height, had thin stems, looked rather poorly, and the stem was not flexible. If you tried to bend the stem, it broke like glass.

That specific change in the whole habit of the plant is to be seen from the first until the 60th potency !

The gold series produced on the whole, much smaller plants which looked very poorly.

We were quite satisfied with this experiment. It showed that sunflowers were favourably affected by a tin treatment. Of course this was not yet a sufficient proof to justify saying that the sunflower is influenced by the planet Jupiter. We are perfectly aware of this. Until now we can only state that we can prove with ample material that tin solutions are influenced by the planet Jupiter and sunflowers seem to select tin solutions, which influence their growth favourably.

The following year we decided to go on with these experiments, not only repeating the treatment with tin and quicksilver potencies, but also studying the influence of the other metal salt solutions, gold chloride, copper sulphate, iron sulphate, lead nitrate, and silver nitrate.

Each series was carried as far as the 60th potency and each potency was represented by 5 plants (= 300 sunflowers to each series). That makes, for the seven series, 2100 plants ; and besides these there were also the water control plants. Of course we should like to give a detailed description of all these experiments and the highly interesting charts, showing the maxima and minima and how many flowers were borne by each stem, the diameter of the flowers, etc. We have to limit ourselves here, as we have for all the previously mentioned experiments. Every detail has been observed and duly noted. In summing up the result, we can only state the maximum growth for each series :

Maximum growth for the Water control plants :				2.75 metres
"	"	"	" Silver nitrate series :	3.05 "
"	"	"	" Quicksilver chloride "	3.60 "
"	"	"	" Copper sulphate "	3.12 "
"	"	"	" Gold chloride "	2.85 "
"	"	"	" Iron sulphate "	3.22 "
"	"	"	" Tin chloride "	3.97 "
"	"	"	" Lead nitrate "	3.28 "

Or we may arrange the figures differently, according to the decreasing or increasing growth, thus :

1.	Tin chloride	...	...	...	3.97 metres
2.	Quicksilver chloride	...	...	...	3.60 "
3.	Lead nitrate	...	...	...	3.28 "
4.	Iron sulphate	...	...	...	3.22 "
5.	Copper sulphate	...	...	...	3.12 "
6.	Silver nitrate	...	...	...	3.05 "
7.	Gold chloride	...	...	...	2.85 "

Experiments with Maple Seedlings.

Maple seedlings grow rather quickly, and, having a beautiful maple tree growing in the garden of the Biological Institute in Stuttgart, we took the opportunity of making experiments with these seedlings. Culpeper states, that the Maple Tree is under the dominion of Jupiter. "The decoction of the leaves or bark strengthens the liver." There is not only a relation between the planets and the metals; planets and plants; but also a relation between the planets and the different organs. Since the oldest times the Liver has been connected with the planet Jupiter, the Heart with the Sun (Gold); the Kidneys with the planet Venus; the Spleen with Saturn; etc. Culpeper says of the Maple tree, that "it is good to open obstructions of the Liver and Spleen and eases the pain which proceeds from thence."

Here Culpeper's description is right. The maple tree is definitely under the government of Jupiter, as our experiments proved very successfully. Again it happened that Tin and Quicksilver produced a favourable effect on the seeds. But later on, in watching the development of the small trees, we found that treatment with tin chloride helped the plants to develop a beautifully shaped top and to grow healthy and strong. The quicksilver treated trees had the inclination to branch off again and again, to have a poorer foliage, of lighter green, and like the sunflowers, the thin stem broke easily when touched.

It would be good if more people would take an interest in such experiments. Many problems could be solved. If we knew the right times for planting trees, much money and labour could be saved.

INTRODUCTION

It may seem strange to speak about "smallest entities" in agriculture, but it is absolutely necessary that farmers and gardeners learn to understand this important phenomenon.

The problem of minutest quantities, or better "smallest entities," was studied from 1920 in the Biological Institute at the Goetheanum (Stuttgart) and later on in the Biological Institute at Bray, Berks. The attempt to find a remedy for "Foot-and-Mouth Disease" led us to the question of "smallest entities." What is the right concentration of the specific remedy to be injected? Rudolf Steiner suggested that the effect of different dilutions on germinating plants should be studied. From 1920 until to-day we have been studying this interesting subject. One might think that this is a *medical* problem rather than an agricultural one. Of course it is a medical problem in that we are looking for a certain remedy, but it becomes an agricultural problem as well if we study how the growth of plants is affected by substances which are diluted, or rather potentized.

What does "potentize" mean? Exactly what the word itself expresses. In potentizing a substance, we increase its effectiveness. We make the substance more potent. The strange thing about potentizing is, that we have to reduce the amount of the substance which we want to make more potent. In everyday life we are accustomed to think: if we want to make something more effective, we have to take a bigger quantity. For instance, if we want to make coffee sweeter, we take a second teaspoonful of sugar (provided we have it!). In homoeopathy we are told just the opposite thing. If we want a stronger action from a certain remedy, we have to potentize it, that means dilute it in water or alcohol, again and again, in a rhythmical way.

That is the first and most important thing we have to learn: to discriminate between matter and force. Matter can act in two different ways: as matter, or as the specific force behind the matter. In everyday life we ask only for matter, for quantity, and we do not even stop to think, that there is something like a force which is active in every kind of matter. Sugar is not only sweet—that is **one** quality of sugar we discover by means of our rather coarse sense of taste. Besides being sweet, sugar has many other qualities we cannot taste, but our organism realizes them; only we are not aware of everything that sugar does in our organism.

Now we must raise another important question: What do we want in reality? The substance itself, or the inner quality of the substance?

For instance, a farmer may be convinced that his soil needs lime. How does he solve the problem? Usually he digs a large amount of lime into the soil. Again and again he will dig in lime.

Let us study the influence of "smallest entities" of lime on the germination of wheat. We put a certain number of seeds in a control dish with water. Then we dissolve one gram of calcium hydroxide in ten parts of water and shake the mixture for some minutes; then we have the *first* potency or a *dilution* of 1 : 10.

We take 1 part of the first potency; mix it with 9 parts of water; shake for the same time, and we have the second potency, or a dilution of 1 : 100. We may continue this process of diluting as long as we like. Usually we make our experiments up to the 60th potency. Having finished all the potencies, we insert the carefully selected seeds, and, a few days later we compare the results.

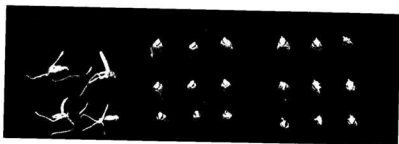


Fig. 40. Water control 1st potency (1 : 10) 2nd potency (1 : 100)

The seeds inserted in the first potency of lime scarcely start to germinate. The effect of lime in such a high concentration is thus proved to be unfavourable. The seeds in the second potency begin to sprout, whereas those in the water control are much more advanced in growth.

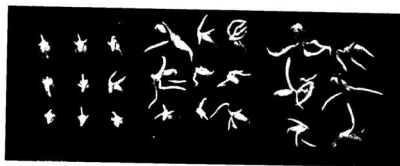


Fig. 41. 3rd potency (1 : 1,000) 4th potency (1 : 10,000) 5th potency (1 : 100,000)

The 3rd potency is more advanced than the 2nd, the 4th is of about the same value as the water control, the 5th already surpasses the water control and has definitely better developed roots.

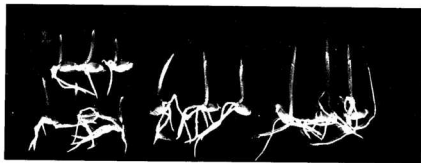


Fig. 42

6th potency (1 : 1,000,000) 7th potency (1 : 10,000,000) 8th potency (1 : 100,000,000)

The 6th potency is more advanced than the 5th, and the 7th and 8th potencies show still more increase in growth. That means, if we observe these few potencies, that a dilution of 1 : 100,000,000 of lime produces a much better growth than a lower potency. The lime works much more powerfully if we use a minute quantity. Whenever we have to introduce lime into a soil we need not dig in a large quantity of the solid matter, but spray a certain potency carefully on the surface of the soil.

It is an easy, and a very economical way of helping the soil which is lacking in lime.

Chapter II.

Experiments with Wheat grown in the Open

In this experiment the grains were soaked in the usual series of potencies, in one case in sulphate of iron, in another in chloride of quicksilver. After soaking for some hours, the grains were dried and then planted out in the garden, each separate potency in its own little plot, and were allowed to grow to maturity without further treatment. The effects of the earlier experiments with germinating grains could now be observed in the full-grown plants. Some plants showed a luxurious growth of rich green stalk followed later by full heavy ears of corn, while others turned yellow quite early and showed but meagre growth.



Fig. 43

shows some examples from the group soaked in potencies of quicksilver chloride. The first pair of ears (3rd potency) shows practically the same results as the normal non-treated grains which were used as control. The 7th potency shows enlarged growth, the 15th is smaller than the water control and the 16th potency is quite definitely a minimum. The 24th potency reaches maximum growth, the 28th potency is a second minimum, while the 30th potency again shows a growth beyond the normal.



Fig. 44

demonstrates the result of the experiment carried out with iron sulphate. The 3rd potency is of about the same growth as the water control plants, the 7th potency shows increased growth; the 17th and 19th potencies are the first minima in this series; the 24th potency reaches maximum growth; the 29th potency represents a second minimum. The 30th potency is again beyond normal growth.

If we study the influence of smallest entities on plant growth, we find a very interesting law. According to the substance we are using, we can find that the 1st, 2nd and sometimes even the 3rd potencies are unfavourable for plant growth ; then with increasing dilutions (we can also say with decreasing concentration) the process of germination starts. At a certain dilution it reaches the same point as the water control ; then it surpasses the water control, even to a considerable extent. Many substances reach a first maximum at the 7th potency (1 part of the substance diluted in 10,000,000 parts of water). Then again we find that the plants decrease in growth gradually. We nearly always get very tiny and sometimes even distorted plants, between the 11th and 18th potencies (according to the substance ; silver, for instance, has an early minimum between the 11th and 13th potency ; gold salts show rather a late minimum about the 18th potency). After the first minimum is reached, the plants show increasing growth again. That means we are using much smaller entities, or much higher dilutions, whichever expression you like ; so **matter can be entirely neglected**. **The chemical tests come to an end, but the living plant organism shows us quite clearly there is something influencing its growth favourably or unfavourably.**

The plants reach a maximum, they are much bigger than the water control plants, at about the 21st to 24th potencies. After having reached the maximum, the plants again decrease gradually. We reach another minimum at about the 28th potency and so on. A rhythmical process, producing maxima and minima reveals itself through these experiments. Thousands of experiments have been carried out since 1920, with many varieties of plants, and about 300 different mineral salts and plant juices. The result is beyond any doubt.

Chapter III.

Experiment in the Open with *Hyacinthus Candicans*

To make quite clear what has been said, we add a short report on an experiment with *hyacinthus candicans*. We selected a large number of first-class healthy bulbs. Some of the bulbs were allowed to germinate in water for control purposes. The other bulbs (five for each potency) were inserted in potencies of silver nitrate (from the 1st to the 30th potencies). On Supplement XI we reproduce one series. The 1st potency destroyed the bulb completely, so no germination could take place. The 2nd potency produced only a tiny sprout ; the 3rd reached nearly the growth of the water control plant, only no flowering stem could be developed. The 4th surpassed the control pot considerably ; then the growth gradually diminished again. The 12th potency represented a first maximum, the 14th the first minimum: a tiny, deformed plant with no flowering stem. The 15th and 16th potencies were also unable to produce flowers. The 21st potency represented the maximum for the whole series of thirty potencies. The second minimum appeared at the 28th potency.

Sometimes we get a clear rhythm in steps of seven, as we see in this experiment. The first minimum, 14th potency ; maximum, 21st ; second minimum, 28th potency.

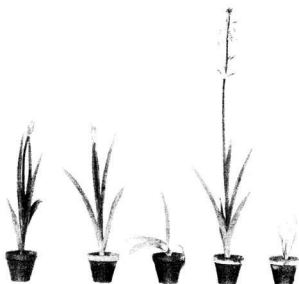


Fig. 45

Water	7th	14th	21st	28th potencies.
The exact figures are :				
	1st minimum	Height	40 cm.	
	2nd ..	..	28 cm.	
	Maximum	..	140 cm.	
	Water control	..	105 cm.	

We have also to notice, that there is not only a difference in measurement, there is also a difference in time. While the 12th and 21st potencies were in full bloom, the water control had not yet fully developed the flowering stem. At the time when the 1st potency reached 140 cm., the water control plant only reached about 80 cm. The 21st potency having faded long ago, the water control plant gained its maximum length with 105 cm.

There are many possibilities for studying this extremely interesting subject in the open, or in the laboratory, or in the glasshouse. The laboratory experiments last only a fortnight. For the details we refer to our various publications* since

*L. Kolisko, *Physiologischer und physikalischer Nachweis der Wirksamkeit kleinster Entitäten*, 1923.

L. Kolisko, *Physiologischer Nachweis der Wirksamkeit kleinster Entitäten bei 7 Metallen*, 1926.

L. Kolisko, *Physiologischer Nachweis der Wirksamkeit kleinster Entitäten*, 1932.

L. Kolisko, *Mitteilungen des Biologischen Institutes am Goetheanum*, No. 1, 1934 ; No. 2, 1934 ; No. 3, 1935 ; No. 4, 1935.



Fig. 46
Graph showing the measurement for the above series of 30 potencies.

1923. For each potency we use about 30 grains. The grains are allowed to germinate on glass dishes in the respective potencies; then they are placed in larger pots filled with garden soil which has never had any artificial fertilizers. Every other day they are watered with the potencies, and after a fortnight, the small wheat plants are carefully taken out of the pots, the roots cleaned from the adherent soil, and the measurements of each plant are taken. In a fortnight two leaves have developed. The length of each leaf and the roots are measured, then we reckon out the average length for each potency. One experiment means 2,000 plants and the water controls; four measurements are to be taken on each plant (first leaf, second leaf, internodes, roots), that is 8,000 measurements. With a well-trained assistant it is possible to do the whole procedure in about three hours. (I am very grateful in this connection to Mrs. L. Deman who helped me for many years, taking down the measurements with great speed and exactness. Later on Miss Beck succeeded her in this responsible task.) Then, of course, the addition and division of the figures for each potency, and the making of the graph has to follow.

Of course you need time and much patience for exact experiments. But this is not the task of a farmer or a gardener, it is the task of the scientist and his helpers ; later on the farmer and gardener may benefit from their work.

Chapter IV.

THE EFFECT OF "SMALLEST ENTITIES"

studied on the following salts :

- | | |
|-----------------------|-------------------------|
| (1) Potassium Nitrate | (5) Potassium Phosphate |
| (2) Sodium Nitrate | (6) Superphosphate |
| (3) Ammonium Sulphate | (7) Potassium Sulphate |
| (4) Sodium Phosphate | (8) Potash Permanganate |

It is interesting to study the effects produced by some of the salts which science of to-day thinks necessary for plant growth :

Potassium Nitrate (KNO_3)

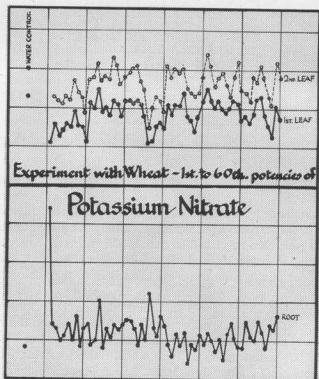


Fig. 47 Graph of an experiment with wheat from 1st-60th potencies

The first plant indicates the average growth of the water control (30 plants). The 1st potency (a dilution of 1 : 10) developed only one tiny leaf and very short roots. That means that the concentration 1 : 10 nearly killed the germinating power of the seeds. The 2nd potency is better, but the result still smaller than the

water control plant. We see that the graph slowly climbs upwards, reaches the first minimum at the 10th potency; the 13th potency is better than the water control; the 17th is the first maximum. Then again the growth decreases and increases, and reaches a minimum at the 26th and 27th potency; and again growth increases and decreases. The third minimum is reached at the 38th potency; the second maximum is reached at the 41st; the fourth minimum at the 58th potency.

The roots produce the first minimum at the 14th and the second at the 27th potencies; the maximum is at the 37th potency.

Examining the whole graph, we are justified in saying that there are two distinctive phases to be seen. The first one continues until the second minimum; then one complete rhythm comes to an end, which repeats itself in an harmonious way.

Such a graphic picture of the influence of smallest entities on plant growth can be considered the reflection of the inner dynamic of the material which has undergone the process of potentizing.

Potentizing is a rhythmical process. The solid matter has been dissolved either in water or alcohol in a certain proportion (1 : 10, or 1 : 100). The process of dissolving can be either by stirring, if we have a large quantity; or by shaking, if we have a small quantity. It is important to know the right length of time for these procedures. For the details I again refer to my various publications on this subject. Then we must continue to keep the same proportion for diluting, and the same interval for shaking.

There is another way of making potencies, if we use substances which cannot be dissolved in a liquid. In this case we make a fine powder of the substance to be potentized, and rub the powder together with a more or less neutral substance (for instance, lactic sugar) in the same proportion, 1 : 10. Then we again take a tenth of the first potency, and rub it into nine parts of lactic sugar for about two hours that makes the 2nd potency, and so on.

Nitrate of potassium, or nitrate of potash, or saltpetre, or simply nitre, is very much used as a fertilizer. It occurs in considerable quantities in the soil of certain hot countries. It is artificially manufactured from refuse animal and vegetable matter, which is mixed with calcareous soil. In this way calcium nitrate is formed. When this substance is treated with potassium carbonate it yields potassium nitrate=nitre.

Everybody knows that nitre has many uses. One we have already mentioned, is as a fertilizer. Therefore, we have studied this substance from the standpoint of agriculture. But nitre is also used in metallurgical and chemical processes, and last, but not least, in the manufacture of explosives.

We proceed to the study of **Sodium Nitrate** (NaNO_3) :

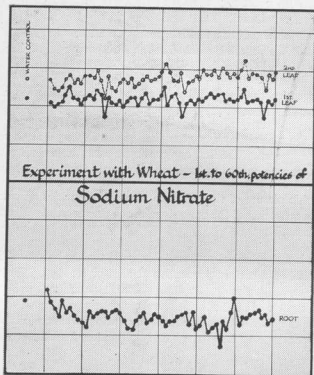


Fig. 48 Graph of an experiment with wheat, 1st-60th potencies

This graph differs very much from the previous experiment with potassium nitrate, although we may even find a certain similarity. For instance, the movement of the first six potencies resembles, to a great extent, the graph of potassium nitrate. But the minimum is reached only at the 15th potency; then the plants gradually increase in growth and reach the first maximum at the 31st potency. The second minimum we find at the 36th, the third minimum at the 57th potency. The second maximum is reached at the 52nd potency.

The roots gradually increase in growth, until the 46th potency, and produce only one minimum at the 50th potency.

But the whole dynamic of sodium nitrate differs immensely from the dynamic of potassium nitrate.

Sodium nitrate dissolves very easily in water. This quality makes it understandable that we find this mineral in workable quantities only in regions with very low rainfall. The most important deposits of sodium nitrate are found in the Atacama Desert (Northern Chile); that explains why it is also called Chile saltpetre. This salt is used in great quantities as a fertilizer, for the production of nitric acid and other chemical purposes.

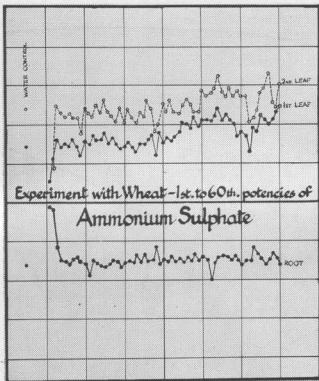


Fig. 49 Graph of an experiment with wheat, 1st-60th potencies

Ammonium sulphate produces a strange phenomenon right at the beginning. The first two potencies are rather tiny plants. Therefore, it is astonishing to see the jump to the 3rd potency. It already surpasses the water control plant; and then the plants decrease again. One feels, that this sudden jump does not mean a favourable influence for the plant. It is, more or less, a big shock inflicted on the plant organism; therefore immediately afterwards the plants are thrown back again to their due limits. The first minimum is reached as early as the 9th potency, the second at the 28th.

Then the second phase of the graph begins, reaches the maximum at the 44th potency, the third minimum at the 52nd and again a maximum at the 57th potency. But, it seems, after the third minimum, the second phase has come to an end, and a third one begins; the end we cannot see, because it must happen at about the 75th or 80th potency.

The roots reach maxima at the 11th and 42nd potencies, minima at the 28th and 53rd potencies.

Again, the dynamic of this substance is different from that of the previous ones.

Ammonium sulphate occurs in nature as yellowish-grey mealy crusts in the neighbourhood of volcanoes. It is also found in guano deposits, together with other ammonium sulphates.

It is extensively used as a fertilizer.

Sodium Phosphate

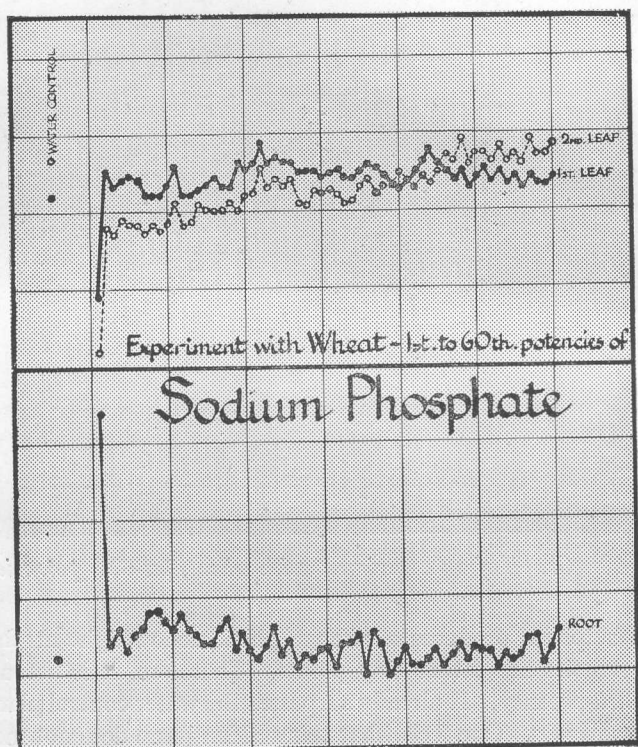


Fig. 50 Graph of an experiment with wheat, 1st-60th potencies

The first glance reveals immediately a graph representing three periods of a rhythmical process. The first period reaches as far as the 22nd potency; the second until about the 46th potency; then the third period (which is incomplete) begins.

Another interesting detail is that the two leaves cross at the 40th potency. The second leaf becomes longer than the first one. This fact has a special meaning.

Studying the growth of wheat plants in daylight, in intensified light with the help of electricity, and in a dark room (these experiments are fully explained in Chapter VI), we get certain characteristic differences. If the plants grow under normal conditions, they develop two leaves in a fortnight. During summer time the

second leaf is longer than the first one ; and during winter time, the opposite phenomenon is seen. If we increase the light influence, plants always produce a short first leaf, and a much longer second leaf. The internode is shortened. If the plants grow in a dark room, the first leaf is much longer than the second one, and the internode is also lengthened.

Knowing these interesting facts about light and darkness, we must say that sodium phosphate produces in the higher potencies the same phenomenon as increased light.

We proceed to another phosphate, to find out, if this " light " phenomenon is again produced in the growth of wheat plants. **Potassium Phosphate :**

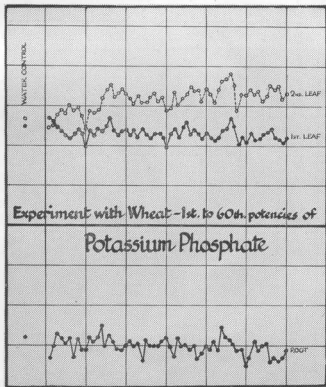


Fig. 51 Graph of an experiment with wheat, 1st-60th potencies

The water control plant shows only a small difference between the first and second leaf. That means, during the time of the experiment there was not much sunshine.

The 1st potency is represented by a plant with a large first leaf ; that means it has an effect similar to " darkness." The 2nd potency still shows that phenomenon, but not so strongly ; the 3rd potency produces a longer second leaf, that is : " light "

phenomenon, and for the rest of the graph we see quite clearly a considerable "light" influence in comparison with the water control plants. (Of course, this experiment has been carried out in a glasshouse, so that every pot had the same amount of external sunlight. There was also no difference of warmth or humidity in the air or soil.)

The first minimum is reached at the 10th, the second at the 30th, the third at the 48th potency. The first maximum at the 16th, the second at the 46th potency.

The roots produce the minima at the 14th and the 44th potencies, the maxima at the 24th and 50th potencies.

Superphosphate

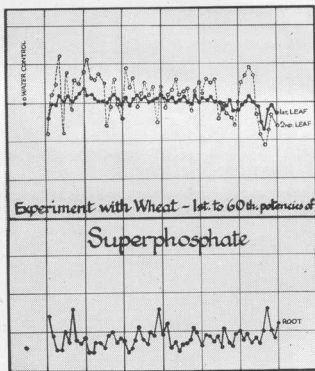


Fig. 52 Graph of an experiment with wheat, 1st-60th potencies

This is the most commonly used phosphatic fertilizer. The water control plant indicates only a small light influence, the first and second leaves are very close together. The 2nd potency already produces a plant which is even better than the water control. Of course, there is only a small difference. The 3rd is much better, and we see quite distinctly that the second leaf is longer than the first one, that shows light influence. The 4th potency is much too big and is immediately followed

by a very tiny plant. This is a clear picture of a shock. It is as though you push a pendulum very hard, so that it swings violently to the right; then it happens quite of itself, that it has to swing as violently to the left. Therefore we could never suggest using, for instance, such a low potency of superphosphate. The effect on the plant is not favourable. The 11th potency is the first maximum, the 16th the first minimum, the 29th the second minimum, the 49th the third minimum and the 57th the fourth. The 53rd potency is the second maximum.

The roots show the first minimum at the 7th, the second at the 29th, and the third at the 57th potency.

It is quite interesting to see that nearly all potencies produced a "light" effect, only the minima indicate a "darkness" effect.

Potassium Sulphate

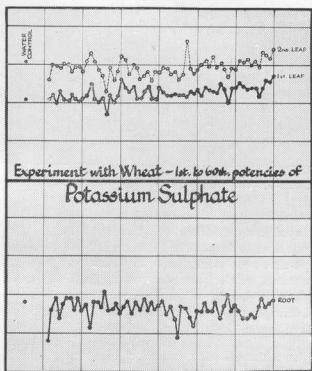


Fig. 53 Graph of an experiment with wheat, 1st-60th potencies

The first maximum occurs at the 12th potency, the second at the 37th potency. The first minimum at the 16th, the second at the 48th potency.

Maxima of the roots occur at the 12th and 35th potencies

Minima " " " " 16th and 48th potencies

to such an extent that we cannot trace an atom of it. That is the strange phenomenon—we **trespass from the field of matter into the sphere of pure forces.** For twenty years we have studied this subject carefully. We tried again and again, invented new experiments, searched for every possible mistake. The experiments have been carried out in the laboratory and in the open. We controlled the influence of light, of darkness, of electricity, of magnetism, of warmth, of humidity, and the influence of the different seasons. We tried different mixtures of soil : pure leaf mould ; pure sand ; the plants were raised in earthenware pots, in glass dishes, on filter-paper, on cotton-wool, in test-tubes, one single seed in one test-tube (swimming on the surface of the liquid, with a small ring of glass wool to prevent it submerging). There were thirty test-tubes for each potency, hundreds of water control test-tubes. Still the result was the same : with increasing dilution at first increasing growth ; then decreasing ; minimum growth far below the water control plants ; and then again increasing growth, with the maximum far above the water control plants, and again decreasing. . . .

The living organism of the plant is influenced by a 50th potency even more strongly, than by a high concentration of matter. As chemists we must say : " there is nothing ; it is only water." But the plant tells us : " there is something more powerful than matter." The free force is acting, is radiating through the liquid. We do not really like to say " radiating." It is true that radiating forces stream through the potencies, but nowadays, to use the expression " radiating force," means something more or less material to nearly everybody. It is something which emanates from a certain point, and goes like a straight line to another point somewhere in space. But a radiating force is everywhere, it is not a physical thing, it cannot be touched, it cannot be seen, it cannot be measured, it cannot be put on the scales ; it can only be experienced in its effects. But it can be studied as exactly as any other branch of natural science.

We want to point out, that although examples with different fertilizers are given, we do not suggest using these fertilizers in potencies instead of in large quantities. The reason for this will be given in other chapters of this book. We only wish to give exact scientific proofs, showing that the growth of plants can be influenced by minute quantities—but we must know which substances the different plants really need.

THE SILICA PROCESS IN NATURE.

Silica plays an important part in the earth crust. In reality it is the element which we find most frequently. According to the newest investigations, about 25.74% of our earth consists of silica. That is an enormous amount if we compare it, for instance, with the amount of calcium (stated to be only 3.4%) or sodium, 2.6%; potassium, 2.4%; magnesium, 2%. Silica unites with oxygen and forms SiO_2 . We find it in beautifully formed crystals, like rock crystals, for example. If we take into consideration that nearly all the silica is bound to oxygen, then we get more than half the earth crust consisting of silicon dioxide 55.3%. But that is not all; silicon dioxide is also to be found in other minerals, and metal oxides, so that the full amount of silica substance in our earth crust has been estimated at about 97%.*

As mentioned before, we either find silica in beautiful crystals: rock crystal, or the so-called smoky quartz (a brown variety), or amethyst (a mauve variety); or we find it amorphous like onyx, cat's eye, or jasper. Here again we may differentiate between silicates containing water like the beautiful semi-precious stones, the opal, or without water like the agate.

The crystallized silica is extremely hard and cannot be dissolved in water. Every farmer or gardener knows, that if he has a sandy soil, the water just runs through.

Quite another thing happens if the soil contains much clay. Clay **absorbs water, silica cannot absorb it**. It is also very difficult to melt silica. It is possible to make a kind of glass out of silica, which has a great resistance to any change of temperature. Such a silica glass may be heated until it is glowing red; and if it is dipped in cold water or even liquid air, it will not crack. This means, that silica does not expand much if heated. It is also not easily attacked by acids. Therefore we can understand that silica glass is used for chemical purposes. Ultra-violet rays may pass silica glass.

Nearly all natural mineral waters contain a small amount of silica. In sea water, rivers, springs, ground water, in the hydrosphere, everywhere we find some silica.

We enter the sphere of life, and find silica again in the plant kingdom. The diatoms, silica-algae deposit millions of tons of silica at the bottom of the sea. We find it in the peripheric parts of nearly all the Gramineae, and there is one plant which contains an enormous amount of silica substance: *Equisetum arvense* (horsetail).

* Prof. Dr. W. Vernatsky, *Geochemie*, Leipzig, 1930. Akademische Verlagsgesellsch.

In the animal kingdom the Radiolariae have a silica skeleton, then there are the silica-sponges; and fish scales, butterfly wings, feathers of birds, animal hair, all contain silica.

The human organism has silica in the supporting tissues, cartilages, bones, intestines, lungs, skin, hair, nails, teeth and eyes.

The Russian scientist, Prof. Dr. W. Vernadsky, who has written a remarkable book about **Geochemistry**, is convinced, that no living organism can exist without silica. Still it is not yet quite clear what part this element plays. It is partly used for the formation of the skeleton, of the tissues and cells in plants and animals. It is concentrated in the membranes, in the connective tissues and the epithelium. But we also find it in the protoplasm and sometimes we even find the hypothesis that the colloidal nature of protoplasm may be due to the presence of colloidal silicic acid. This would mean, that organisms contain silica only for the sake of its physical properties. There are no proofs whatsoever for this assertion.

It is quite interesting to study the circulation of the silicates in nature, and an enormous amount of work has been done in this domain by scientists all over the world. Still the question remains : **What is the real task of silica?**

Rudolf Steiner mentioned in his agricultural lectures in June 1924, that silica has the quality of absorbing light beneath the surface of the soil and makes it possible for the light to act there. **There is light above, but there is also light within the soil, and this light can act, and can be used by the plants : that is the task of silica.**

Quite the opposite effect is produced by Humus. **Humus excludes the activity of light.**

It may seem strange, but why should it not be possible for silica to act as a kind of catalyst for light beneath the surface of the soil? At least we can try to find out if this is true.

Chapter VI.

Influence of Light and Darkness on Plant Growth

Before entering into the details of these experiments I want to say a few words about plant growth in general. Of course, it is familiar to us all, but sometimes things which are very familiar to us, can be studied from various aspects.

We take the seed and put it into the soil. Then we water the soil and germination takes place. Two elements must work together : soil and water. The seed begins to sprout, tiny roots and a tiny leaf—but they grow in opposite directions. We say the roots grow geocentrically, the leaves heliocentrically. That means the roots have the tendency to grow towards the centre of the earth, the leaves towards the centre of the sun. The roots grow in the direction of the force of gravitation, the leaves against gravitation.

When the shoot pushes through the soil it comes into contact with two other elements : Light and Air. Sunlight and warmth, the whole atmosphere, partake now in the development of the plant. Between these two polarities : Light and Darkness, influence of the Earth and influence of the Sun, or still better, between earthly and cosmic forces, plants grow. It would be insufficient to limit ourselves to the sun forces, because we are able to prove that the moon also has a great influence upon plant growth. We have dealt with the moon influence in Part I, Chapter II. We shall never be able to understand plant life if we cannot understand the interplay of earthly and cosmic forces.

We can study the chemical composition of the soil ; or try to understand plants with the help of a microscope ; or at last burn the plants and analyse the ashes. But with all these methods we shall never find **life**. Such methods are only apt for studying the **inorganic**, but a plant is a living being, it grows, and can reproduce another living plant. **We need a science of life.**

We must admire natural science and be grateful for all the investigations carried out in the last centuries. But this natural science presents the plant to us, as a very complicated chemical product. The plant as a living organism is not explained.

How do light and darkness influence plant growth? This problem has been studied very carefully by many scientists. Some scientists* are of the opinion that plants grow more quickly in darkness, because the protoplasmic synthesis is quicker in light. Also the formation of albumen is more vigorous in light. Others say : " It is not so simple that we may say, light hinders plant growth. At first, light produces increased growth, and later retards it." There are also scientists who believe that electric light of sufficient power influences plant growth in a way similar to sunlight.

We studied the influence of light and darkness to begin with under quite normal conditions. Nature enabled us to do this. During the course of a year there is increasing and decreasing sunlight. We started our experiments in January, and finished them at the end of December. Each week we inserted thirty grains of wheat in glass dishes filled with garden soil. The soil used for our experiments was carefully prepared, and we never used any artificial fertilizer. Five different varieties of wheat were studied every week, and for each variety we used two pots

* H. Euler, Braunschweig 1909, "Grundlagen und Ergebnisse der Pflanzenchemie."

each containing thirty grains. After a fortnight the plants were taken out of the soil, the roots carefully cleaned from the adherent soil, and then we measured the length of the first leaf, the second leaf, the internodes and length of the roots of each plant. Fifty-two experiments were carried out in one year; each experiment lasted a fortnight. These were laboratory experiments. The glass dishes were placed on a large table near a window facing south. Of course, during the whole year we did not change the conditions in the room. The only change was due to the light which streamed through the window, according to the changing seasons.

A corresponding series of experiments was carried out in a dark room.

We quote the average figures for the different months of the year, 1932 :

(a) Experiment in daylight

<i>Month</i>	<i>1st leaf</i> <i>cm.</i>	<i>2nd leaf</i> <i>cm.</i>	<i>Internodes</i> <i>cm.</i>	<i>Roots</i> <i>cm.</i>
January	13.0	10.7	5.2	15.4
February	6.9	4.2	2.3	12.4
March	8.8	10.1	4.0	18.6
April	11.3	15.5	4.8	20.9
May	13.4	18.8	5.4	14.2
June	12.6	20.1	4.3	18.0
July	17.0	25.0	5.5	15.6
August	15.0	23.0	5.8	23.0
September	13.8	21.8	4.8	17.4
October	9.9	15.5	4.1	19.2
November	8.0	9.0	3.0	16.5
December	7.3	4.5	2.3	14.0

We find that in January, February, December, the first leaf is longer than the second; and for the rest of the year the second leaf is longer than the first one. Maximum growth is in July, minimum in February, as regards the leaves. Maximum growth in August, and minimum in February as regards the roots.

(b) Experiment in the Dark Room

<i>Month</i>	<i>1st leaf</i> <i>cm.</i>	<i>2nd leaf</i> <i>cm.</i>	<i>Internodes</i> <i>cm.</i>	<i>Roots</i> <i>cm.</i>
January	5.5	0	0	9.8
February	20.1	0	0	17.5
March	16.1	0	0	18.1
April	18.1	0	0	17.5
May	28.0	0	0	17.0
June	21.6	14.5	9.0	16.6
July	35.0	28.7	17.3	17.8

<i>Month</i>	<i>1st leaf</i> <i>cm.</i>	<i>2nd leaf</i> <i>cm.</i>	<i>Internodes</i> <i>cm.</i>	<i>Roots</i> <i>cm.</i>
August	31.0	28.0	14.1	15.5
September	29.3	19.8	13.7	14.7
October	23.0	13.0	8.1	16.9
November	8.5	0	0	11.0
December	0.7	0	0	3.7

During the first five months, only the first leaf develops ; the next five months produce the second leaf ; still it is smaller than the first one ; and the last two months of the year again produce only the first leaf.

We notice that the length of the internodes is considerably increased in comparison with the experiment in daylight. Maximum growth is in July as regards the leaf, in March as regards the roots.

The plants growing in a dark room show, of course, the well-known phenomenon that the leaves are yellow instead of being green. The internodes which usually are a shade lighter green in daylight than the leaves, are perfectly white, like the roots, in the dark room.

We can take the average growth of the whole year for these experiments, and get the following figures :

	<i>1st leaf</i> <i>cm.</i>	<i>2nd leaf</i> <i>cm.</i>	<i>Internodes</i> <i>cm.</i>	<i>Roots</i> <i>cm.</i>
Daylight	11.4	14.9	4.3	17.1
Darkroom	19.7	8.7	5.3	14.7

We can say that light makes a longer second leaf, darkness makes a longer first leaf, and reduces the length of the roots. This statement we can make in comparing an experiment carried out in daylight with an experiment carried out in a dark room. But we can make the same statement by studying the growth during a whole year in daylight, because the same phenomenon is to be seen during the " dark " months of the year. In January, February and December, even in daylight the first leaf is longer than the second.

What happens if we increase the influence of light ?

We made many experiments using electric light. For instance, plants were allowed to grow during the day under the normal influence of the sunlight, and then during night had an additional influence of electric light.

Other series had only electric light from morning until evening, instead of sunlight.

Another series had electric light incessantly (day and night) for a fortnight. We used an " Osram Nitra " bulb, 1,000 watt, and had to make special arrangements

to avoid an increased effect of heat. The plants grew very quickly and in a fortnight developed three leaves instead of two. Many plants even produced four leaves.

The average figures for an experiment consisting of thirty control dishes with thirty plants in each (900 plants) follow :

			1st	2nd	
1st leaf	2nd leaf	3rd leaf	Internode	Internode	Roots
cm.	cm.	cm.	cm.	cm.	cm.
14.0	25.0	32.0	4.5	3.3	27.0

Returning to the experiment carried out in daylight during a whole year, we had the average measurement of 11.4 cm., for the first leaf, and 14.9 cm. for the second leaf. Increased light increased the phenomenon already mentioned : viz that the second leaf increases considerably in growth under increased influence of light.

We may even say, that the difference between the first and second leaf indicates the amount of light influence. **The larger the difference between these two leaves the greater the amount of light which has influenced the plants.** With daylight we have a difference of 3.5 cm., and with the electric light the difference is 11.0 cm.

The Influence of Silica and Humus on Plant Growth

Having studied for years the influence of light and darkness on wheat plants, we then undertook experiments in connection with the influence of silica on the one hand, and humus on the other. Now we may well ask : What is humus ? There is no chemical formula for humus. We can define what silica is, but we cannot give a scientific definition for humus. Still it is a most important factor in every soil and determines its fertility. It means the amount of **life** in the soil : organic matter from plants or animal bodies in disintegration, rich in oxygen, nitrogen and carbon. A soil rich in humus, means a soil in which the **process of life** is in full swing. A black soil is nearly always rich in humus. The best test is to take a handful of soil and to smell it—and then you smell the “ life,” if you have a sensitive nose. You will recognize by its texture that it is well worked through by earth worms, it has a certain amount of moisture—but above all it smells of life. A really good farmer does not need a chemical analysis or a microscopic test ; he feels and smells the soil, and can tell you how much fertility it contains. But we will deal with this question in detail in later chapters.

In order to study the influence of silica and humus, we made the following experiments. Assuming that silica has the capacity to activate the light in the soil, then we may expect that an experiment with wheat germinating in a soil which contains a certain amount of silica, will show us the phenomenon of “ light ” according to our previous studies. That means we shall find an intensified growth of the second leaf in comparison with a control experiment in the same soil without silica.

Description of the Experiment

Fifty glass dishes having about the same proportion as an ordinary earthenware flower-pot were filled with the same garden soil that had been used for all our previous experiments ; thirty grains of wheat were inserted in each of these fifty pots. These seeds had to be selected carefully in regard to their germinating capacity.

Fifty glass dishes were filled with the same soil, mixed with a small amount of pure silica sand. The sand had been pulverized so finely that it felt like flour. Thirty grains of wheat were inserted in these pots.

Light : “ Osram Nitra ” bulb, 1,000 watt.

Duration : Continually day and night for twelve days.

The first glass dishes received the direct rays of the electric light ; then we erected above the glass dishes a channel of strawboard blackened inside and outside. The channel had a length of ten metres. Imagine the light streaming into this channel with decreasing intensity. At the end of the channel there was almost complete darkness. We hoped to show by this arrangement, how plants grow in a greater or less intensity of light, from what was almost darkness up to a degree of light equal to 1,860 candlepower. We had two rows of glass dishes each containing fifty pots in a space of ten metres covered by this black channel.

The glass dishes, which we filled with the mixture of soil and silica, were dipped at first in distilled water so that some water adhered to the glass ; then we put a thin film of silica sand on the sides of them (about 22 gm.). After having inserted the seeds, they were covered with the soil (1 cm.) and again some silica sand was sprinkled on the top.

Small differences in temperature could not be completely avoided. We tested the temperature with thermometers inserted in each pot.

Observations during the Experiment

All the plants germinated quickly and continued to grow satisfactorily. The first pots which were under the direct influence of the light, produced plants of a very intense green colour ; the greater the distance from the light, the more the vivid green lost its intensity. Then gradually the green changed to yellow. We had succeeded in changing over from an experiment in intensified light to an experiment in darkness. The first plants were standing perfectly upright ; further on, the plants tried to reach the light, as though running towards it ; the light was attracting them very strongly. In the final portion of the channel the plants were again standing upright, as in a dark room, only without being able to produce chlorophyll.

The experiment was concluded at the end of twelve days, and we took the measurements. Whenever we used electric light we had to end the experiment as early as the twelfth day, because the plants grow much more quickly than in ordinary daylight ; but they lack inner strength. The leaves are thin and weak, and break easily. Of course

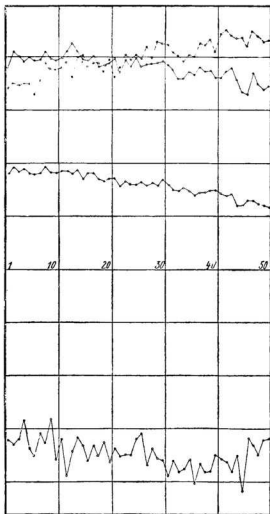


Fig. 55 Experiment with decreasing light-intensity and with garden soil

it is abnormal to let the plants grow under the influence of electricity instead of the sun, and this abnormality must show itself somehow in their whole structure.

No. 1 represents the pot standing in darkness, and 50 the pot immediately under the electric light. We see that the internode is very short, owing to the light ; and it increases with decreasing light. The greater the darkness, the greater the distance of the internode from the seed.

The first leaf is larger in the darkness until the 14th pot inclusive. The second leaf is larger than the first one from the 26th until the 50th pot.

Between there is a sphere where light and darkness battle with each other ; up and down and up and down.

The roots grow longer, the greater the intensity of light.

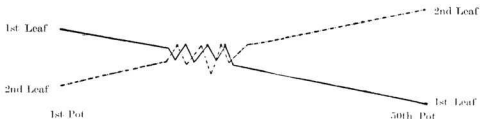


Fig. 56 Simplified diagram of the above graph

Description of the Experiment with Silica

The graph represented in Fig. 52 shows also three different parts. The first part showing distinctly the effect of darkness between the 1st and 20th pot ; the second part is rather short, between the 20th and 26th pot ; and the third part between the 27th and 50th pot shows distinctly the influence of the light.

The internode slowly increases towards the darkness.

The growth of the roots is not so well defined as in the previous experiment.

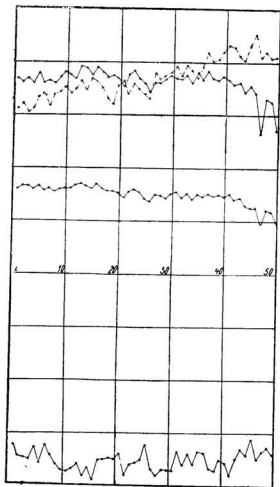


Fig. 57 Experiment with decreasing intensity of light soil mixed with silica

Can we find in these two graphs that the silica has produced a "light" phenomenon? We have to look at the following points :

Light increases growth of the second leaf ;

It decreases the internodes ;

It increases the growth of roots.

If we examine these two graphs carefully, we find that the effect of darkness is less distinct in the experiment with silica, because the maximum growth of the first leaf is reached with 21.2 cm. in garden soil, whereas the silica mixture reaches only 19.5 cm. as the maximum effect of darkness.

As regards the internode we see at the first glance, that the silica mixture does not make the internode rise as far in the darkness as garden soil does. That means again : the effect of darkness is lessened in a soil mixed with silica. The maximum reached for the internode in garden soil is 9.7 cm., the minimum is 6.0 cm. ; the silica mixture has a maximum at 8.5 cm. and the minimum at 4.7 cm.

Comparing the two graphs as regards the roots, we see quite distinctly, that the garden soil produces shorter roots with increasing darkness ; whereas the silica mixture remains nearly at the same level from the end to beginning. That means the darkness did not effect the root growth in the silica mixture as it did in a soil without silica.

We find phenomena of light which we can attribute in these experiments only to the presence of silica.

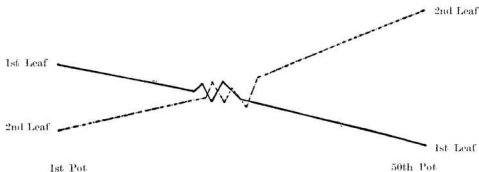
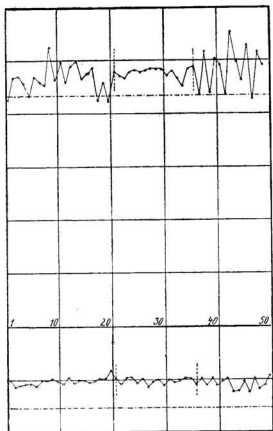


Fig. 58. Simplified diagram of the above graph

The graphs obtained for the weight are also of great significance. They are sub-divided into three phases: light—darkness—and the phase in between. Fig. 59 demonstrates this phenomenon quite clearly.



*Fig. 59 Weight of the wheat plants grown in decreasing light,
garden soil*

Our next experiment consisted of three series to study the difference between our usual garden soil, the soil mixed with silica and a black soil containing active humus substances. Each series contained twenty-five glass pots with thirty grains in each. This time we did not use electric light, only daylight streaming through the black channel. The first pot was nearly in complete darkness, the 45th was standing in plain daylight, and during the night the room was in normal darkness. The experiment was carried out for a fortnight. During the whole time it was seen that the "humus" series was retarded in growth, in comparison with the other two series.

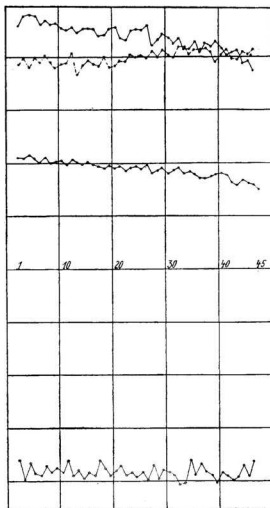


Fig. 60 Experiment with Wheat in decreasing daylight with garden soil

The growth of the first leaf increases from light to darkness, or we can also say it decreases from darkness to light. The graph falls steadily in this direction from 24.0 cm. to 18.0 cm.

The second leaf has the opposite movement, it increases from darkness towards light, from 18.2 cm. to 20.5 cm.

The internode steadily increases with increasing darkness. Pots 1 to 31 show the influence of darkness; pots 32 to 42—the second part of the graph—show the battlefield between light and darkness; pots 43, 44, 45 show the phenomenon of light.

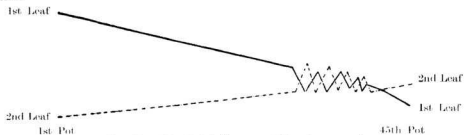


Fig. 61 Simplified diagram of the above graph

The next series contained a mixture of our garden soil with silica sand. We mixed the sand with the soil thoroughly.

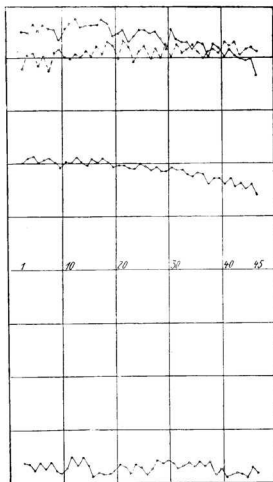


Fig. 62 Experiment with Wheat in decreasing daylight—soil mixed with silica sand

The growth of the first leaf decreases with increasing light from 23.5 cm. to 18.3 cm.

The growth of the second leaf increases with increasing light from 19.0 cm. to 20.5 cm.

The internode slowly decreases from darkness to light, from 10.5 cm. to 7.0 cm.

Pots 1 to 28 show the influence of **darkness**. Pots 29 to 38 again the **battlefield between light and darkness**. Pots 39 to 45, **light influence**.

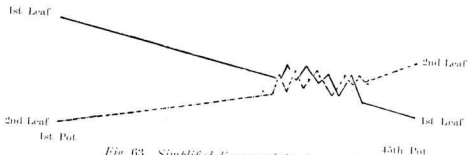


Fig. 63. Simplified diagram of the above graph

The third experiment with "humus" :

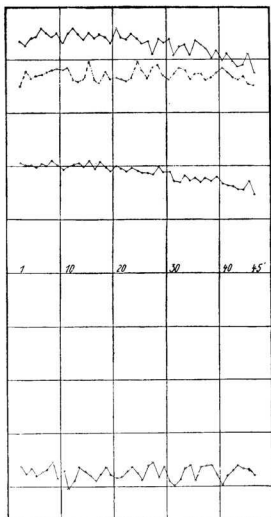


Fig. 6A Experiment with Wheat in decreasing daylight—plants growing in "humus"

The growth of the first leaf decreases with increasing light, from 23.0 cm. to 18.5 cm.

The growth of the second leaf slightly increases from darkness towards light.

The internode decreases from darkness towards light from 10.5 cm. to 7.3 cm.

There is not a single pot in the whole series showing the influence of "light."
The second leaf is always smaller than the first one.

There is no middle part where light and darkness fight with each other.

The experiment with "humus" shows only the phenomenon of "darkness," which, of course, increases with increasing outside darkness.

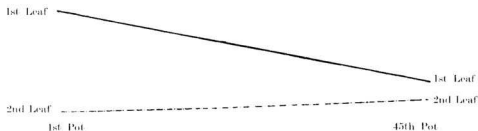


Fig. 65 Simplified diagram of the above graph

The result of this simple experiment is extremely interesting. Rudolf Steiner's assertion that silica activates the light in the soil, and "humus" brings about a "darkness" influence; or perhaps it is better to say it hinders the light from acting, proved perfectly true. The first experiment with garden soil had three pots showing "light"; the second experiment where silica was mixed into the soil, could show the phenomenon of "light" as far as the 7th pot. That means: in reality the external influence of light lessens from the 25th to the 39th pot, yet the plants still got light from within.

The third experiment proves that "humus" excludes the action of light. All the three series were exposed to the same amount of light, but the plants could not receive it in quite the same way, according to the varying composition of the soil.

These experiments have perhaps partly solved the question: What is the use of silica to plants? Silica is of no nutritive value for the plant; that means, silica is not considered to be necessary for plant life. It can easily do without it. But silica is everywhere, even in the atmosphere, so, although it has no actual nutritive value for the plants, it helps them to receive different cosmic entities which they need at least as much as the nutritive substances. Without the cosmic entities streaming through them and through the soil they would not be able to use the food offered to them. Silica activates the light in the soil; that is a cosmic entity. Light does not belong to the earth, it comes from the cosmos.

Certain plants, especially roots, require a sandy soil if they are to prosper. Carrots, beetroots, celeriac, and potatoes grow best in a sandy soil, because silica helps them to obtain light inside the soil.

Other plants which like to grow in a sandy soil are, for instance, *Achillea millefolia* (Yarrow), *Plantago* (Plantain), in mountain regions *primula acaulis*, *gentianas acaulis*, *carlina acaulis*. The name "acaulis" means "stemless." These plants

produce only a tiny stem. This reminds us of the characteristic phenomena described in our experiments, namely, that light shortens the internodes, shortens also the first leaf, and enhances the growth of the roots. The green colour of the shortened stem is darker, and also the green of the leaves is more pronounced.

The stem has more of the character of the leaf. This fact is also mentioned by other scientists. Intense electric light can produce chlorophyll even in the inner bark of woody plants. The plant is, as it were, pushed back into the soil.

Darkness, on the other hand, changes the stem in the other direction, it grows longer and becomes silvery white like the roots, and the roots are shorter. The plants are driven out of the soil.

In mountain regions it is obvious that plants get more light, so they show these characteristics in their growth.

THE SILICA PREPARATION FOR AGRICULTURAL PURPOSES ACCORDING TO RUDOLF STEINER'S SUGGESTION.

Sometimes we have a soil which has not enough silica, but which is rich in humus: a heavy soil. So we must introduce silica. Rudolf Steiner suggested the *homoeopathic use of specially prepared silica*. For several years we had studied the influence of minute quantities, or "smallest entities." Rudolf Steiner mentioned these investigations which had been carried out in the Biological Institute at the Goetheanum (Stuttgart) when he suggested using certain substances in **homoeopathic quantities for agricultural purposes**, because now there was a tested scientific basis for it. Smallest entities produce immense effects on plant growth, and, when used as remedies, on the human organism also. He suggested that silica should be pulverized very finely like flour. Then it should be moistened with water to make a thin paste, and a **cow's horn** filled with it. The horn must be buried in good soil about half a metre deep and left there during the summer. This procedure concentrates the qualities inherent in silica, and makes it extremely useful for agricultural purposes. In autumn the horn is dug out of the soil and kept until wanted.

For one acre of land we use 1 gram of this silica dissolved in about 10 litres of rainwater. The most important thing is to stir this small quantity of silica in the 10 litres of water; it must be done quickly, and with a wooden stick, stirring in one direction until the water forms a deep whirlpool, then it must be stirred in the opposite direction, and so on for at least one full hour.

Two questions arise: (1) Can silica be potentized? For it is not soluble in water. (2) Is the silica which has been kept in the cowhorn and buried in the soil during the summer, any different from ordinary silica?

Substances which are not soluble can be potentized from the homoeopathic point of view. The substance has to be ground and pulverized with a special machine, sometimes for many hours. Then one part of it is mixed with a more or less neutral substance—lactic sugar—and worked into the lactic sugar with the same machine for about two hours. A microscopical examination will show whether the mixture is a homogeneous one. That is the 1st potency. Again we take 1 part of the 1st potency and mix it with 9 parts of lactic sugar, and work these two substances together for two hours; then we have the 2nd potency, and so on. Years ago we studied the difference between potencies made by this "dry" method, and potencies of soluble substances dissolved in water or alcohol. We will give one example—for instance, **sulphur** rubbed into lactic sugar.

One gram of the 1st potency is dissolved in 10 cm. of water; 1 gram of the 2nd potency in 10 cm. of water, and so on, until we have 30 potencies dissolved. Seeds of wheat are inserted in these solutions until germination begins. Then the seeds are placed in glass dishes with garden soil and are allowed to grow for a fortnight. During this period they are only watered with distilled water.

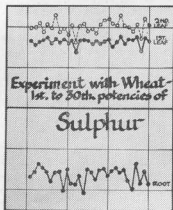


Fig. 66 Experiment with Wheat
1st to 30th potency of Sulphur

was continued till the 60th potency. Only the first half is reproduced here, because for agricultural purposes we need not make use of higher potencies.

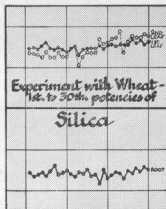


Fig. 67 Experiment with Wheat, 1st to 30th potency of Silica

The water control indicates that the first leaf is longer than the second, that means not much light. The experiment was carried out in 1931 in the second half of May. It is quite an interesting graph. All the potencies show improved growth compared with the water control; slowly increasing at the beginning until the 5th potency, then decreasing until the minimum is reached at the 13th. At the 18th the second leaf becomes longer than the first (light influence), the maximum is reached at the 23rd; then the first leaf is again longer; and for the rest of the graph, the second,

We see the first maximum at the 7th potency, the first minimum at the 12th, the second minimum at the 28th potency; the second maximum at the 23rd. A doctor will know how these potencies affect the human organism. The patient takes a small amount of the white powder which many people might think is only lactic sugar; but if an experiment is made with plants, the living organism of the plants reveals the specific power of each potency. Therefore we must conclude that **insoluble substances can also be potentized.**

If that is so why should it be impossible to potentize silica? We pulverize rock crystal to a consistency of fine flour—it takes a long time, of course—then we potentize it with rain-water and insert the wheat. This experiment

The internode varies, but usually is shorter than the water control (light influence).

The roots reach the minimum very early at the 7th and the maximum at the 18th potency.

The next problem is : if we put the silica in the cowhorn and bury it beneath the surface of the soil during the summer, does this strange procedure change in any way the qualities of the silica ? We must confess, that when the silica is taken out of the soil, it looks different, although it is difficult to say how. Perhaps it is not so " white," as it was before.

We try to solve this new problem by the same method. We potentize the " prepared silica " and start our experiment at the same time as the previous one.

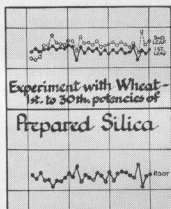


Fig. 68 Experiment with Wheat, 1st to 30th potencies of " Prepared Silica "

This graph looks different. It is best described by saying it looks more harmonized. The first maximum is reached at the 6th potency, the second leaf is longer than the first one. That means " light " from within. The unprepared silica has the maximum at the 5th, but the " light phenomenon " is not to be seen. So we must conclude that the " prepared silica " exercises a stronger influence.

The first minimum occurs at the 12th, a distinct second minimum at the 27th, a second maximum at the 28th. The internode for the greatest part of the graph is shorter than the water control (light phenomenon).

The roots have the first maximum also at the 6th, the second at the 28th the first minimum at the 12th, and the second at the 27th potency.

Prepared silica differs favourably from unprepared silica.

If these experiments are repeated for years, differences will be found. Every year is different from another. The conditions beneath the soil are different in 1931, from 1932, or 1933, and so on. In order to demonstrate the difference between

different years we give an account of the experiment carried out in the same way during summer 1934. That is to say, the cowhorn containing silica was buried in the soil in summer 1933, and the experiment was carried out in the second half of May 1934.

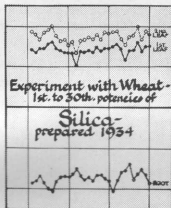


Fig. 69 Experiment with Wheat, 1st to 30th potency Silica prepared 1934

The water control indicates that the first leaf is smaller than the second, and that means "light." Although the experiment was carried out at the corresponding time of the experiment in 1931, we find that more light was available for the plants. This fact changes accordingly the whole graph. The second leaf is longer from the 1st to the 30th potencies. The first maximum occurs at the 6th potency (exactly the same point, only stronger), the second maximum at the 28th (also the same point). The first minimum is at the 12th, the second at the 24th potency (three potencies earlier).

[The internode is shorter than the water control for all potencies (light phenomenon).

The roots have the first maximum at the 6th, the second at the 21st potency ; the first minimum at the 12th, and the second at the 25th potency.

For the most part, the graph of 1934 is identical with the graph of 1931.

Silica has proved useful indeed for increasing plant growth in the garden as well as in the field. It is only applied to green plants. It is of no use spraying silica on the bare soil before the green leaves are there. Rudolf Steiner suggested taking quite a small amount of the prepared silica, the size of a "pea," or even only the head of a pin, and stirring this into about 10 litres of water. But the mixing process has to be done very carefully, for at least one hour as previously described.

But something else is also most important. Silica has the capacity to mediate the cosmic influences of light, but it is also closely connected with warmth. The right way of stirring the silica is to use only **warm** water.

One gram in 10 litres is about the 4th potency. According to our experiments the best result was obtained using the 6th *potency*. Having stirred the silica into warm water, this liquid is sprayed or sprinkled on the top of the green plants. They are helped in their growth, they can produce more chlorophyll, they develop into strong plants. 10 litres are enough for one acre.

Many farmers and gardeners have used this prepared silica with good results. Control experiments show an increased harvest for different grains from 10-30%.

It should also be used for leguminous plants, and for carrots, beetroots, turnips and potatoes, in soils lacking silica.

THE SILICA PLANT—*Equisetum arvense* (Horsetail)

as a remedy for various plant diseases

This plant likes to grow in fields, meadows, and uncultivated sandy soil. It is rough to the touch, reaches a height of about 16 inches, blooms in March-April ; and produces its vivid green sterile shoots after the decay of the reddish-brown fertile shoots in June-July, when it is best to gather them. *Equisetum* is a **silica plant**. It is a real gatherer of silicic acid in the first place. Of course there are many other substances to be found in this plant, like oxalic acid, equiset acid, bitter substances and resin. The ashes contain much aluminium, potassium chloride, etc. It is well known as a medicine since earliest times. We find it described in Culpeper's **British Herbal** : " there are many kinds of this herb, which are but knotted rushes, some with leaves, and others without. The great Horsetail at the first, has heads resembling asparagus and afterwards grow to be hard, rough, hollow stalks, joined at sundry places at the top, a foot high, so made as if the lower parts were put into the upper, where grow on each side a bush of small long rush-like hard leaves, each part resembling a horsetail. At the top of the stalks come forth small catkins, like those of trees. The root creeps in the ground, having joints at sundry places. This herb grows in wet grounds. It springs up in April, and has its catkins in July, it seeds in August and perishes in winter. Government and Virtues : this herb belongs to **Saturn**. It is very powerful to stop bleeding either inward or outward, the juice of the decoction being drunk, or the juice, decoction or distilled water applied outwardly. . . . The decoction, taken in wine, provokes urine and helps the stone and strangury. The juice or distilled water used as a warm fomentation is of service in inflammations, pustules or red wheales and other breakings-out in the skin."

Pliny mentions *equisetum* also, and says that it has a great power of stopping bleeding ; it would even be sufficient to hold the plant in the hands. He speaks of it also as a remedy for diseases of the spleen.

Albertus Magnus (12th century) mentions the same qualities.

In our present-day medicine we find horsetail used again as a remedy for kidney diseases, for haemorrhage of the lungs, or stomach ; it provokes urine and in homoeopathy it is used for cystitis, strangury and dropsy.

Rudolf Steiner suggested *equisetum* as a wonderful **remedy for plant diseases**. Of course we have to be careful in speaking about " plant diseases." There are no plant diseases in the same sense as that in which we speak of animal diseases. An animal falls ill in a different way. There are inner organs which can get diseased, inner causes of illness, whereas if we study plant life we always find that plants get diseased from outside. Either it may be the wrong composition of the soil, the natural balance in the soil being disturbed, so that the plant cannot get the right food ; or in some years the weather conditions are unfavourable, there is too much water or not enough water, and so on.

If a plant is diseased it means that the normal contact between the plant and the universe has been disturbed. The plant is originally healthy and we have to bring back the plant to this natural condition.

Very often we find that insects, or caterpillars attack plants only when something is not in order in the general life of the plant. To combat these diseases means simply to strengthen the vitality of the plant. There are nearly as many damaging insects as there are plants. To-day we fight against these pests with many chemical substances. A whole industry has been created to combat them.

In Part I, Chapter II which deals with the influence of the moon on plant growth, it was pointed out that the forces of the moon are mediated through water. If there is a full moon and some days previously there was rain, so that the soil is well moistened, then we have the best natural conditions for putting our seeds in the soil. They will sprout quickly and grow into strong, healthy plants. Plant-life makes use of the forces of the full moon with the help of the moisture of the soil. In a perfectly dry soil, even the best forces of the full moon could not help. Moon and water belong together, as do **silica** and **warmth**. These give us the best conditions.

Sometimes it happens that the moon acts too strongly, and that is when there is too much moisture during the full moon period. Too much life is generated and **too much life is as bad as not enough life**. The former provides just the right conditions for different so-called plant diseases. Parasites increase, pests appear and fungi. There is too much "moon" in the soil, too many life forces, and we have to re-establish the right balance with equisetum.

Rudolf Steiner suggested making a rather strong tea of equisetum; then diluting the tea and using it in homoeopathic quantities for the diseased area.

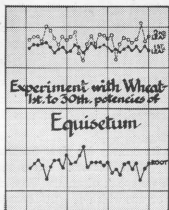


Fig. 70

Experiment with Wheat, 1st-30th potencies. Equisetum Arvense

We studied this problem carefully. At first we made the tea (1 part of the drug to 10 parts water=10%); we brought it to boiling point, and then let the tea simmer slowly for about one hour. It is necessary to boil equisetum for rather a long time. The tea is of a light green colour, and we found it best not to use it immediately, but in a few days' time, when a certain smell is developing.* We made our usual experiment to find the right potency. We potentized until the 60th potency, then inserted the wheat into the different potencies, and watched the different growths for a fortnight.

Here we see quite an energetic graph. The first maximum is at the 5th potency; the second at the 28th; the first minimum at the 14th; and a second at the 21st potency. The

* See capillar dynamolytical test on next page.

first maximum shows prominently the second leaf much longer than the first one, and indicates a strong "light" influence of the silica substance, and that is just what we need to oppose the too strong moon influence in the case of plant diseases.

The first and second minimum show the opposite effect on the leaf; the first one is longer than the second. "Darkness" prevails.

The roots have as minimum the 14th, and maxima the 6th and 28th potencies.

Having thus ascertained the right potency of equisetum, we treated all kinds of plant diseases: fungi and mildew, and pests with the 5th potency, with excellent effect.

In some cases we can also use the "prepared silica" 6th potency to obtain the same result. For instance, lice on broad beans can be attacked successfully with a spray of prepared silica. Only it must be done at the right moment. Here it is suggested that prepared silica and not equisetum should be used, because these lice do not appear because of too much "moon" in the soil; they appear at the time when the growth of the beans is checked perhaps through cold weather or drought, and if we can stimulate growth in time, we help the plant to resist the attack of the lice.

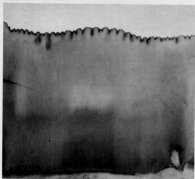


Fig. 71 *Equisetum Tea*, fresh; followed by 1% gold chloride

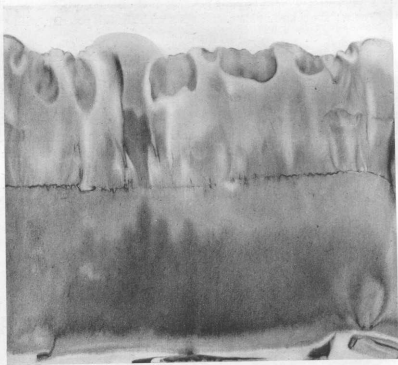


Fig. 72 *Equisetum* Tea matured until the characteristic smell develops;
followed by 1% gold chloride

THE CALCIUM PROCESS IN NATURE.

Calcium also, like silica, plays a great part in Nature, and farmers and gardeners have to know something about the calcium content of their land. Our first question must be about the origin of calcium on our planet earth. Where did it come from? Huge mountains are built up from this substance.

The limestone we find in the South Sea Islands originated from **corals**; that means it comes from the animal kingdom. Much of the mountain region in the Alps, is also built up from corals (the Bavarian Alps, Wetterstein Mountains, Jura Alps, etc.). We find everywhere that limestone originates from the shells of living beings. If we look at **marble**, for instance, the pure, white, crystallized Carrara marble which is used for sculpture, for building material, etc.—it seems to be a perfectly lifeless mineral matter. But here and there we find petrified corals in the quarries.

Of course lime can be dissolved in water (not so silica), then it re-crystallizes and looks like dead mineral matter, with no connection whatsoever with life. Nevertheless, **calcium** originates from living beings.

We have already mentioned the publication by Professor Vernadsky, the Russian geo-chemist, and must mention him here again, because he has collected an immense amount of material which proves beyond any doubt, that all the lime we find on earth has been derived from living beings: "omni calx e vermibus." Dover cliffs consist of pure white chalk, the deposit of millions and millions of shells from tiny living creatures, the Foraminiferae.

And as for **Coal**—everybody knows that it is the remains of plants belonging to previous epochs of the earth's evolution. The same can be said about **Slate**.

To-day science is coming to the conclusion that nearly all the mineral deposits are derived from living beings, that they are the remains of plants or animal skeletons.

It is interesting to remember how geological classification came about. An Italian scientist, standing in the Plain of the Po and looking towards the Alps, noticed that different layers were to be seen in the rocks, and he called the lowest one the "primary" rocks, the next layer "secondary," and the next "tertiary"—these are the limestone formations; and the next was the "quaternary" (Alluvium). That is the origin of our geological classification. At present we count some twelve or thirteen layers, because later some sub-divisions were made.

In these different layers of the earth the remains of specific animals are to be found. The geologists call these animals index fossils. In a particular layer certain specific shells or snails are to be found—so wherever such fossils appear one is able to say to which geological period they belong. Thus the principles of geology are based on the presence of certain petrified animals. The older layer which does not contain fossils is called "archaic."

The question is: Do we not find specific animal residues there because there was no life? Or is it possible that everything was life, that the whole was permeated with life?

If we study geology, and see how much life there has been everywhere, we cannot really think there can have been any epoch in our earth evolution when there was no life at all. There is a certain place in the Jura Mountains—Holzmaden—where nearly all the huge petrified animals have been found, and which now can be seen in various museums all over the world. In Holzmaden (Southern Germany) we find the Triassic Slate Formation. This layer is full of animals. Life cannot be created out of dead matter, but it is the life-process which deposits dead matter. As in a swamp, where all is permeated with life, with slugs and worms and insects, etc., so we have to imagine that once our earth was in a more liquid condition—between solid and liquid—but full of life. **The whole of earthly matter was living substance.**

If we can grasp this, then we can understand better how the whole mineral kingdom of our planet earth has originated out of such living creatures. The earth as a whole was once a huge living being.

There is ample material to prove this as far as the **lime** and **calcium process** is concerned, and also for many other processes in nature. The Russian scientist Vernadsky, who has made extensive geological investigations, is convinced that living beings and dead matter have always existed side by side. He is convinced of the "eternity of life on earth." Life, as such, has never been created on earth—but dead, lifeless matter has originated from the life-process itself. For instance, a living substance like protoplasm, contains many different substances which cannot be discriminated from one another so long as they are in the living organism. If the living organism is killed, then, of course, all the different substances become apparent. In a similar way, life was interwoven in the origin of our planet earth.

In speaking of **Silica**, its resistance to heat and to acids was mentioned, and that it is insoluble in water. Neither heat nor water affect it. With calcium it is different. If we want to understand calcium as a substance, then we must observe, for instance, how it slowly crystallizes out of the water. It is deeply connected with water, but has also the tendency to form a deposit. But lime can only be dissolved in water, if there is also a certain amount of carbonic acid present. If the carbonic acid evaporates—lime is deposited.

That is a general law we find in Nature. If out of a medium something evaporates into the air, another part solidifies, and falls to the earth.

So we see the lime wandering between the solid and the liquid state. This substance has a certain desire, as well for the one as for the other kind of existence. It is eager to be dissolved in water—but it is as eager to fall out as a deposit again. This process is carried out with the help of the carbonic acid. In the sea there are thousands of species of animals and plants which collect calcium. In the living organisms we find exclusively calcium-carbonates.

Calcium-sulphates are deposited from concentrated solutions, where there is no more life left. Calcium sulphate or gypsum can be dissolved in water. For instance, all the Italian mineral waters contain some sulphur. In gypsum we have not only the qualities of calcium, but those of sulphur as well.

Calcium carbonate can be dissolved in water containing a surplus of carbonic acid ; it can be burnt and the carbonic acid driven out ; and then we get quicklime. If lime is heated it begins to emit light, the so-called Drummond's lime-light. This burnt lime has an enormous desire to get into contact with water. If it is slaked the water disappears rapidly into the lime, and begins to boil. The lime has become an alkali.

Calcium Nitrate is formed during the disintegration of nitrogenous organic substances in the presence of calcium.

Calcium Phosphate treated with sulphuric acid, becomes soluble in water ; mixed with calcium phosphate in about equal proportions, it is used as a " fertilizer " under the name of **superphosphate**. Lawes of Rothamsted worked out and patented in 1842 a method for doing this on a large scale. This was the first artificial fertilizer.

Calcium fluoride we find in Nature, sometimes in beautiful crystals, as fluorspar.

Again we turn back to **silica**. It was said that silica is found more on the surface of the earth and less the deeper we go down beneath the surface. The plants deposit silica more or less in their peripheric parts. In the animal kingdom we find it also more or less deposited in the peripheric organs, or forming the shell of the lower animals. The same phenomenon happens in the human organism, where silica is to be found in the skin, nails, hair, and eyes.

Lime, on the other hand, withdraws inside the human body and forms the skeleton. If we look at the way the different substances are distributed in Nature, in all the different kingdoms of Nature, if we try to follow up the steps that are made, then we get a better understanding of what we have to do in agriculture. We must grasp the whole **process** : the silica-process, the calcium-process, the sulphur-process, the nitrogen-process, etc. ; a " process " embraces much more than substance alone.

In the Introduction of this Second Part, we mentioned experiments with calcium hydroxide, and showed the effect of " smallest entities " by means of illustrations. Only a few of the experiments carried out with calcium can be described.

Experiments with Gladioli, 1st to 30th potencies—Slaked Lime

Carefully selected bulbs of gladioli were inserted in the potencies and kept until germination set in. Then the bulbs were transplanted into the garden and the treatment with calcium potencies was discontinued.

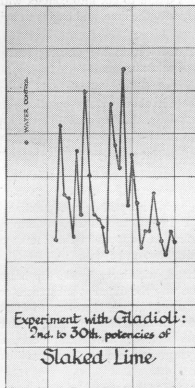


Fig. 73

*Graph of the Experiment with Gladioli
grown under the influence of 1st-30th
potencies—Slaked Lime*

The plants treated with the 1st potency of slaked lime cannot grow at all; the 2nd potency plants are much smaller than the water control and unable to produce flowers. The 3rd potency is too much enhanced in growth for the real benefit of the plant; the 4th is again smaller than the water control; a second jump happens at the 9th potency. The first minimum appears at the 14th; the maximum at the 18th potency. A second minimum is visible at the 28th potency.

Another experiment carried out with quicklime :

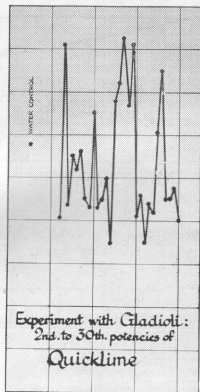


Fig. 74

*Graph of the Experiment with Gladioli
grown under the influence of 1st - 30th
potencies—Quicklime*

Quicklime also hindered the growth of the plants treated with the 1st potency ; the 2nd potency is smaller than the water control plant, but better developed than the identical potency of slaked lime. The 3rd jumps even much higher and the following potencies fall again back under the water control level. The first minimum is reached at the 14th, the second at the 22nd potency. The maximum appears at the 17th. The 26th might be considered as second smaller maximum. There is a certain similarity between these two graphs, but quicklime is more distinct in its character.

Experiment with the much used fertilizer—**Nitro-chalk** :

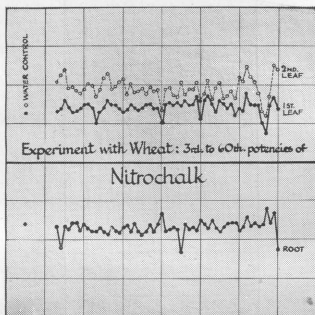


Fig. 75 Graph of an Experiment with Wheat growing under the influence of 1st-60th potencies of nitro-chalk

The graph represents one unit. There is only one phase between 60 potencies. There are two strong minima : the 30th and 57th potencies, and two smaller ones : 13th* and 40th ; two maxima : 52nd and 59th potencies.

The roots show three maxima : 4th, 35th and 60th potencies, and two minima : 30th and 57th potencies. The graph is very harmonious and distinct in every detail.

The first two potencies did not cause germination at all, and the third was already much advanced in comparison with the water control. We refer to Chapter XIII dealing with "The Problems of Artificial Fertilizers," where we point out that the eye specialist, Dr. Thies, wrote about the danger of using nitro-chalk as a fertilizer ; that the farm labourer who handles it gets inflammatory processes on the conjunctiva and cornea very easily.

* We refer to the 13th potency as a smaller minimum because the second leaf is not following the downward movement of the graph as distinctly as it is the case in the 30th potency.

Chapter XII.

SUGGESTIONS FOR THE HOMOEOPATHIC USE OF LIME.

What can we do to bring lime into soil which has an insufficiency of this process?

We have mentioned this in the introduction to the Chapter, "Smallest Entities in Agriculture" :

(1.) We distribute lime in a certain potency over the surface of the soil which lacks lime. According to our experiments, we suggest using the 9th or 10th potencies. This is very **economical**. We owe a great debt of gratitude to Dr. Rudolf Steiner for his idea of introducing the homoeopathic principle into agriculture.

(2.) In making compost heaps (see Chapter IX, Part III), we spread a thin layer of quicklime between the layers of the material that are used.

(3.) In the **Oakbark preparation** (see Chapter III, Part III), we introduce calcium again in homoeopathic quantities into the manure or compost heaps. This calcium comes from the living plant process in the oak tree, and has the faculty of acting prophylactically against "plant diseases." In those cases where plant diseases are to be dealt with and where calcium must take the place of a **remedy**, it is better to take it from a living plant-process and not in its more mineral form as quicklime.

The oakbark preparation has to undergo a special composting process in the skull of an animal. Thus, as a surrounding for the calcium-containing oakbark, that part of an animal which is also built up of calcium—the bony structure of the head—is used.

If we adopt these suggestions, the soil receives all it needs of calcium **forces**, and we need not dig in large quantities of it.

ARTIFICIAL FERTILIZERS.

There already exists such a vast literature about artificial manuring, that it seems almost superfluous to write more about it. Although so many have written about their experiences, farmers and gardeners are still using artificials to a high degree. They have not yet understood that they are rapidly poisoning mankind.

Well-known scientists such as Professor Abderhalden spoke 20 years ago, about the possibility, that in the long run artificial manuring might damage the organic life of the soil. Substances of paramount importance might not be able to develop. In some cases human beings and animals became ill, and the illness was due possibly to artificial manuring. Such scientists admitted that it was not then possible to speak definitely, but said it had to be borne in mind that certain soil bacteria (which are very important for fertility of the land) might be harmed, and it might be unwise to disturb the subtle interplay of all the living organisms through the application of **nitro-chalk**, **lime**, **phosphoric acid**, etc. Some day difficulties might arise. That is what was said twenty years ago.

Is it not strange to imagine the farmer walking over his land and poisoning it purposely? He has to protect himself against the artificial manure he is using, or he may suffer injury. For instance, his eyes are in danger. An eye specialist, **Dr. O. Thies** wrote about this problem in 1929 (*Deutsche Landwirtschaftliche Presse*, 4th April, 1929). He enumerates the different artificials, and speaks about the specific damage they produce. **Thomasschlacke** (Basic Slag) contains phosphoric acid, silicic acid and quicklime; they are apt to damage the conjunctiva and cornea of the eyes.

The effect of **Calmit** is similar, but even more damage may be done to the cornea.

Nitrochalk also gives rise to inflammatory processes on the conjunctiva and cornea. All those who work in nitro-chalk factories show these symptoms. It has even been noted, that once a farm labourer got some of the nitro-chalk into his mouth, nose and eyes on a windy day. He became delirious and complained of headaches, due to the phosphoric hydrogen being generated through the contact of humidity with calcium carbide.

Ammonium sulphate has the same effects as those mentioned above.

Nitrophoska and **superphosphate** are much more dangerous. Nitrophoska contains a mixture of nitric acid, phosphoric acid and some potassium salts. The injury caused to the eyes is very severe. Heavy inflammations, changes in the cornea, sometimes tumours and even complete loss of the eye may follow.

Still more harmful is the use of superphosphate.

That is the opinion of an eye specialist who had to deal with effects of artificial manures on people whose job it was to work with this material.

But it is not only the eye which may suffer. We read also about severe **lung disease** caused through the influence of artificials. Workmen who are constantly

mixing those substances in the mills, may get some of the powder in their respiratory system, and then malignant diseases of the lungs start, which often prove fatal.

Of course, farmers and gardeners who are not in constant contact with these substances, are less liable to injury from them. Then it is considered to be more or less accidental.

Perhaps the farmer has some open sores on his hands, and the powder enters through them into the circulatory system and leads to blood poisoning. Or if the farmer happens to have an inflamed throat at a time when he is scattering the powder on his land, then the powder may affect the respiratory passage which is already inflamed, and such cases may also end fatally.

One is therefore officially advised not to let persons deal with artificial manures who have open wounds or furunculosis. Especially when using nitro-chalk, it is advisable to have the body well protected, to wear heavy boots, to protect the eyes with glasses. It is wise to have grease on the unprotected skin, and cotton-wool in the nose, and to keep the mouth shut. It is better to breathe outside the clouds of powder.

Who would imagine that a farmer has to do all this in manuring the land, which afterwards has to bear fruits for human nourishment?

That is only the first part of the treatment ; **the soil gets poisoned.**

The next step has to do with the seeds. The **seeds** have to be **protected** against diseases which might attack them. So they are dipped into a solution which contains **quicksilver**. Then they are well protected. The amount of quicksilver is relatively small, and anyhow, one is not obliged to eat the seeds which have been treated with that "protective" solution ; and, of course, the plants which grow out of these seeds cannot contain quicksilver.

Some scientists have investigated carefully, to see if the new plants were free from quicksilver, and came to the conclusion that there is still a tiny amount of it to be found. Prof. Stock*, in particular, made many experiments in this direction. He had himself once suffered from the consequences of severe quicksilver poisoning, so it is understandable that he was interested in studying this problem thoroughly. Prof. Stock even found small quantities of quicksilver in **bread**. Of course these quantities were very small and could only be found by extremely subtle chemical tests. Such small quantities are not harmful—so science says. But, perhaps, after some time, if people go on eating small amounts of quicksilver in their daily bread, those quantities accumulate in the organism and then suddenly quicksilver poisoning arises. That is another point of view some scientists take.

Of course it is not enough to protect only the seeds, something has to be done about damage caused through various insects, caterpillars, etc. on fruit trees. Let us poison them, too. This time we take **lead arsenic** for a change. It is a pity that all the bees seeking their share of honey are killed by sucking deadly poison out of

* Geht Quecksilber aus Saatgut-Beizmitteln in das geerntete Korn und in das Mehl über ? Prof. Dr. Alfred Stock und Dr. Zimmermann. Zeitschrift für angewandte Chemie, 41, Jahrg, Nr. 51. (Does quicksilver, contained in preparations for the treatment of seeds, enter into the harvested grain and flour ?).

the flowering trees. Never mind, we have saved the harvest, and, of course, the fruits will not contain any poison.

Perhaps some readers will remember that from time to time people have been advised in the daily papers to peel the apples they eat, because there might be some arsenic in the skin. It cannot be washed off. So we have the substantial influence of lead on the skin of the apple, and the non-substantial, radiating influence of lead in the apple.

Once somebody had the bright idea of powdering the forests from aeroplanes. This method has been tried in America in 1921, and, later on, in Germany. It seemed quite successful as far as the trees were concerned. It was not quite so good for the animals. Many rabbits, hares, deer and birds were killed. It was supposed that the birds had eaten the poisoned caterpillars. Is it not really a vicious circle in which we are going round and round, and do not even notice it? We save the trees and kill the animals. We protect the seeds and make human beings ill.

Why must we work against Nature? Should we not try to understand and help Nature?

The list of poisons is not yet finished. Another very well-known and commonly used poison is **Copper**. To combat the Peronospora disease which attacks the vine, the plants are again and again sprinkled with copper sulphate. What happens then? At first the earthworms disappear from the soil. They are not fond of copper. Consequently the soil begins to lack humus. But of course, we manage to combat Peronospora. Slowly we must increase the amount of copper if we are to continue to get good results. Who has not seen vineyards with the grapes hanging heavily on the branches, and covered with a blue film of copper sulphate, all the green leaves vigorously sprinkled with copper? Sometimes people wonder if they do not eat copper when they buy grapes.

Let us briefly review what is to be found in literature about the treatment with copper. The juice of grapes in the year 1930 contained in a certain district, a considerable amount of copper, about 30 to 50 milligrams in a litre.

Animal diseases occurred after the use of copper sulphate against insects on fruit trees in many districts. The disease is vividly described. **Changes occur in the liver and kidneys of the animals.** The cells are destroyed in these organs owing to the accumulation of copper. Jaundice occurs and damage to the red blood corpuscles. Certain changes take place in the heart. There are swellings on the head, especially on the ears, and sometimes blood in the urine. These diseases occurred shortly after the land had undergone the copper treatment. The animals fell ill about two or three months afterwards. In many cases the illness was fatal.

If we study the effect of copper poisoning upon the human being, we find it described as causing shrinking of the liver. Gallstones contain a considerable amount of copper. Medical science states that this special illness of liver shrinkage and gallstones was formerly not so frequent. It is even possible that people who drink

wine, may, at the same time, imbibe copper. And it has frequently been stated that people suffering from the above diseases were in some way connected with the cultivation of the vine.

It is also known that labourers who have to sprinkle the copper solution on the vine-plants, acquire kidney diseases. Occasionally they get eczema behind the ears.

Sometimes we have **too much science and not enough wisdom or knowledge.** The word "science" has, for many people, a magical sound. If something is "scientific" then it must be all right. So science took possession of agriculture, or we may also say "agriculture became possessed by science." The chemist tells the farmer what he has to do. The chemist is quite right in his sphere, but he is wrong when he touches agriculture. The farmer has lost his knowledge of the forces which work in Nature, he has lost the knowledge of the whole Universe, and has made a poor bargain in exchanging his old wisdom for the new science.

Science could be a wonderful achievement of mankind if we could carry it so far that it again reaches the realm of Spirit. Science alone is not enough. **Our science has lost its contact with life. It is pure science, and that is like the pure substances which are chemically perfectly clean, they are quite pure—but—you cannot live on those pure substances—you must add the vitamins—the life-bearers.** We do not know really what vitamins are—but without them foodstuffs are useless. They cannot support life. So "pure" science is not enough.

Science must find the way to the true fountains of spiritual life—and be transformed into wisdom.

We need new scientists who will endeavour to become pioneers for the spirit; scientists who really understand what **matter** is; who know that behind matter is the spirit. We can never understand matter, if we do not know its background, and whence it comes.

Mankind has been fascinated by the word "scientific." Everybody wants to be scientific—but feels almost ashamed to mention the word "spirit." Science has been born in the West and is overpowering the East. Here, too, it is almost like a disease; at least, I felt it so when I wandered through the dirty streets of Calcutta, where it is scarcely possible to breathe, an unimaginable dirt is everywhere. There are little shops with boards signalling in huge letters "scientific laundry," "scientific druggist," "scientific soap," everything is scientific, not because it has anything to do with what we in the West understand as scientific—but because the word is so fascinating.

O, let us become true scientists again. Let us lift up that priceless jewel from the dust into which it has fallen; let us bring life into the dead, and as we add vitamins to the food that it may nourish the body, so let us strive to find the way from Natural Science to a true Spiritual Science.

EXPERIMENTS WITH ANIMALS TO STUDY THE INFLUENCE OF "SMALLEST ENTITIES."

Experiments with animals carried out to find the decisive proof that " fertilizers " even used in small amounts are harmful :

The whole problem concerned with the use of artificial fertilizers seems to be comprised in **one great question**. Is it possible to prove scientifically that they are really harmful? The present current slogan is : **the amount of poison used, is so small that it cannot harm the human being who consumes the food.**

Therefore it was our next task to find out if this assumption is true, that a small quantity of poison is harmless.

We could not make these experiments with human beings ; on the other hand experiments with plants would also be insufficient to solve the problem of whether small amounts of poisonous substances cause diseases. We had to try with animals. We chose **white mice** for this purpose. We started breeding the mice necessary for a large-scale experiment. The plan was to have at least three different series at the same time, besides the untreated stock.

The first series of mice were to be treated with potencies of **silver nitrate**. The reason for choosing this substance was, that we had already made many hundreds of plant experiments with **silver nitrate** and therefore had a profound knowledge of the effect these potencies produce on growing plants.

The second series were to be treated with some well-known and much-used chemical preparation containing **quicksilver**, and here we chose the preparation sold to many farmers in Germany under the name of **Uspulum**.

The third series were to be treated with a **copper salt**. We used **copper sulphate**, for we also had a rich experience of this salt in plant experiments.

Mice treated with Silver Nitrate

The whole experiment lasted for three years, from 1929-32. We began with the 4th potency (equivalent to a dilution of 1 gram of silver nitrate in 10,000 c.c. water). It did not seem wise to start with a lower potency. Then we went on until the 30th potency. The animals were kept in large wire-meshed cages with sawdust at the bottom. We started the experiment with one pair (male and female) each mouse having the same weight. It was not easy to fulfil this condition. A small margin of difference was allowed. The average weight for the whole series had been fixed at 15 grams, and there was no mouse weighing less than 14.5 grams, or more than 15.5 grams. We selected young, healthy animals which had not yet been paired.

Treatment :

The mice were fed exclusively on wheat soaked beforehand in the respective potency of silver nitrate, and they had also the potency of silver nitrate to drink.

After a fortnight we again noted the weight of each mouse, and compared these notes with our first statement. It was clearly seen, that some mice lost weight, some gained and some remained steady. Still the differences were not sufficient to justify a definite judgment.

We are fully aware that it would be ideal to give a full description of each mouse, to enumerate every detail ; or at least to produce a chart for each mouse showing the progress of weight, for the female mouse the different litters ; the weight before and after the litter. It is quite impossible to do this here. Perhaps we shall have the opportunity of writing a book on this subject only, where all the details could be given. We must apologize for the lack of these in the present publication, which can only summarize the results obtained.

After a few weeks the weight of the silver series showed definite differences, and the graph obtained was almost identical with the graphs we usually get in taking the measurements of an experiment with plants. The minimum of weight occurred at the 11th potency. After about two months this pair of mice died. Not a single mouse in all the other experiments had died until then. We thought that perhaps this happened by chance ; that we had not chosen a healthy pair right from the beginning ; therefore we started with a fresh pair, selected with utmost care. This experiment started on 20th December, and, strange to say, the mice died on 24th February, after eight weeks' treatment with the 11th potency of silver nitrate. Still, not a single mouse had died in the other two series. This time it looked much less like mere chance. We repeated the experiment again on the 23rd March ; the mice died on 7th July. This experiment lasted nearly four months. The mice had paired, but *there was no litter*.

We repeated the experiment on the 20th July. The female mouse died before the litter on the 16th August, and a few days later the male died.

Once more we repeated the experiment on the 28th August and the mice died on the 23rd November.

It seemed useless to go on with this potency, which proved fatal in such a short time. The 11th potency means a dilution of $\frac{1}{100,000,000,000} = 1$ gram of silver nitrate dissolved in 100 million litres water. Here it is hardly possible to speak about "substances"; we really are entitled to speak of **forces**. The higher we dilute a substance, the stronger the force liberated. The substance gets less and less—the force becomes stronger and stronger.

On the other hand, the mice treated with the 18th potency of silver nitrate increased in weight from the initial 15 grams to 43 grams (male and female).

The female mouse had the first litter on 16th July with 7 mice
 second „ 12th Sept. „ 7 „
 third „ 12th Nov. „ 11 „

We kept the second generation apart, and later on the third, and first, and went on with the treatment.

A short time after we started these experiments we noted that all the mice treated with silver nitrate disliked the light. They became highly **sensitive towards any kind of light**. The other two series did not show this phenomenon.

In the course of a year a certain number of the mice showed signs of diseases: tumours on the neck, sometimes along the spine; most of the mice started to get fistulae.

We include the photos of some cases, which are typical for the effect silver nitrate produces, even in higher potencies.

No. 1a. 7th potency. Tumour begins to form on the throat:



Fig. 76 Mouse treated with 7th potency silver nitrate

No. 1b. The same mouse half a year later. The tumour is considerably bigger. The mouse is very sensitive, does not like to be touched. Appetite good.



Fig. 77 Mouse treated with 7th potency of silver nitrate

No. 1c. Post-mortem photo. A second tumour has developed along the spine.



No. 1d. Post-mortem photo. Another view of the same mouse.



Fig. 78 Mouse treated with 7th potency of silver nitrate Fig. 79

No. 2. 19th potency. Post-mortem photo. A larger tumour on the throat and a putrid fistula on the back had developed.



Fig. 80 Mouse treated with 19th potency of silver nitrate

No. 3. 23rd potency. Post-mortem photo. Putrid fistula on the belly.

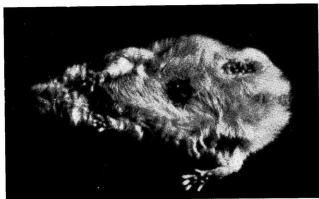


Fig. 81 Mouse treated with 23rd potency of silver nitrate

No. 4. 29th potency. A tumour in the sexual region is visible.



Fig. 82 Mouse treated with 29th potency of silver nitrate

No similar diseases occurred in the other two series, nor did any of the untreated mice show tumours or fistulae.

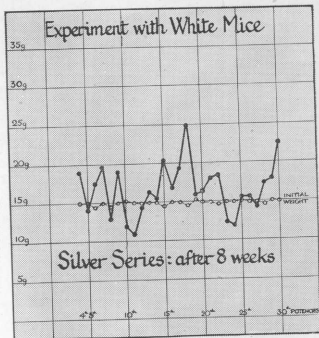


Fig. 83 Graph obtained for the weight of the series treated with silver nitrate after 8 weeks from the start

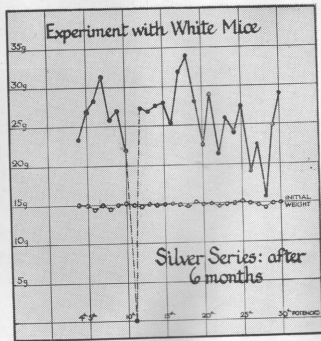


Fig. 84 Graph obtained for the weight of the series treated with silver nitrate 6 months after the start

Figures referring to the above graphs.

Weight of mice

<i>Starting the experiment with silver nitrate</i>			<i>8 weeks later</i>		<i>6 months later</i>	
<i>Potency</i>		<i>grams</i>		<i>grams</i>		<i>grams</i>
4th	...	15.0	...	19.0	...	23.5 -
5th	...	15.0	...	14.0	...	27.0
6th	...	14.5	...	17.5	...	28.5
7th	...	15.0	...	19.7	...	31.0
8th	...	14.5	...	13.0	...	26.0
9th	...	15.0	...	19.0	...	27.0
10th	...	15.3	...	12.0	...	22.0
11th	...	15.0	...	11.0	...	—
12th	...	14.8	...	14.5	...	27.5
13th	...	15.0	...	16.5	...	27.0
14th	...	14.5	...	15.5	...	27.5
15th	...	15.0	...	20.5	...	28.0
16th	...	15.0	...	17.0	...	25.5
17th	...	15.0	...	19.5	...	32.0
18th	...	14.5	...	25.0	...	34.0
19th	...	15.3	...	16.0	...	28.0
20th	...	15.0	...	16.5	...	22.5
21st	...	15.0	...	18.0	...	29.0
22nd	...	14.8	...	18.5	...	21.5
23rd	...	15.0	...	12.5	...	26.0
24th	...	15.0	...	12.0	...	24.0
25th	...	15.3	...	15.5	...	27.5
26th	...	15.0	...	15.5	...	19.0
27th	...	14.8	...	14.5	...	22.5
28th	...	14.5	...	17.5	...	16.0
29th	...	15.0	...	18.0	...	25.0
30th	...	15.0	...	22.5	...	29.0

The experiment with **copper sulphate** was started with the 3rd potency, and it seems astonishing that the mice thrive quite well on this low potency. After eight weeks they had increased from 15 grams to 18 grams, and after half a year's treatment their weight had further increased to 25.5 grams.

It is interesting to study the charts referring to these weights :

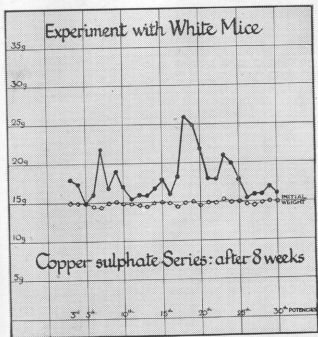


Fig. 85 Graph obtained for the weight of the series treated with copper sulphate 8 weeks after the start

The first maximum is at the 7th potency, the second at the 18th. The minima are not quite clearly marked.

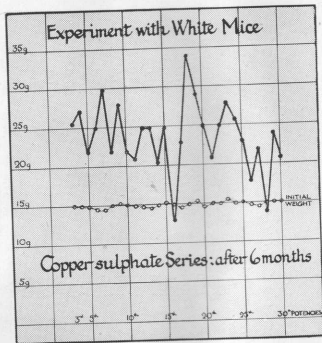


Fig. 86 Graph obtained for the weight of the series treated with copper sulphate 6 months after the start

We find again the 7th and 18th potencies considerably increased in weight. The first minimum at the 16th and the second at the 28th potency.

The series with **silver nitrate** kept nearly the same points. The two maxima : 7th and 18th potencies ; the two minima : 11th and 28th potencies.

The exact figures for the weight follow :

Weight of the mice

<i>Before starting the Experiment</i>			<i>After 8 weeks treatment with copper sulphate</i>		<i>After 6 months treatment</i>	
<i>Potency</i>		<i>grams</i>		<i>grams</i>		<i>grams</i>
3rd	...	15.0	...	18.0	...	25.6
4th	...	15.0	...	17.5	...	27.0
5th	...	15.0	...	15.0	...	22.0
6th	...	14.5	...	16.0	...	25.0
7th	...	14.5	...	22.0	...	30.5
8th	...	15.0	...	17.0	...	22.5
9th	...	15.3	...	19.0	...	28.0
10th	...	15.0	...	17.0	...	22.0
11th	...	15.0	...	15.5	...	21.0
12th	...	14.8	...	16.0	...	25.0
13th	...	14.5	...	16.0	...	25.0
14th	...	15.0	...	17.0	...	20.5
15th	...	15.3	...	18.0	...	25.0
16th	...	15.0	...	16.0	...	13.0
17th	...	14.5	...	18.5	...	23.5
18th	...	15.0	...	26.0	...	34.0
19th	...	15.2	...	25.0	...	29.0
20th	...	14.5	...	22.0	...	25.5
21st	...	15.0	...	18.0	...	21.0
22nd	...	15.0	...	18.0	...	25.0
23rd	...	15.5	...	21.0	...	28.0
24th	...	15.0	...	20.0	...	26.0
25th	...	15.0	...	18.0	...	23.5
26th	...	14.8	...	15.5	...	18.0
27th	...	14.5	...	16.0	...	22.0
28th	...	15.0	...	16.0	...	14.0
29th	...	15.0	...	17.0	...	24.0
30th	...	15.0	...	16.0	...	21.0

The mice were quite lively, but their reproduction was not so abundant as that of the silver series. The average litter was 5 mice, very rarely was there a litter with 6 or even 7 (the silver mice rarely had less than 7, and more often 9 and even 11 young ones in a litter). After sometime these mice behaved very curiously : they were always scratching their ears. They scratched so vigorously that after some time their ears were fringed. The ears of white mice are very tender organs, pink,

and nearly transparent. They must have itched terribly. Entering the room containing all those cages of mice, you could tell from some distance : this is a mouse treated with copper because it is scratching its ear. This phenomenon only occurred in the copper series.

Some potencies developed a tumour inside the ear (the 9th, 17th, 23rd and 26th potencies). We tried hard to get a photo, but these mice would not keep quiet. Even putting them underneath a glass cloche did not help much. Fig. 87 may give some idea of the condition of their ears. We recognize the inflammation in the dark colour and the tumour inside the ear.



Fig. 87 Mouse treated with the 23rd potency of copper sulphate. Tumour inside the ear

We kept the mice, of course, until they died, and then investigated the condition of the inner organs. We give a short description of a few potencies typical for the whole series.

In Fig. 81 we reproduce the organs of a mouse treated with the 3rd potency. At the top of the photo are the lungs and heart ; then both kidneys ; underneath is the liver, with the gall bladder, and at the bottom the spleen.



Fig. 88 Inner organs of mouse treated with 3rd potency of copper sulphate

The **gall bladder is enormous**. Normally the gall bladder of a mouse is only a tiny ball, like the head of a pin ; here the gall bladder is as big as a pea. With the help of a magnifying glass it can easily be seen that the structure of the bladder is not normal ; it is hardened and we even find some nodules.

Fig. 89 shows the difference in size between a normal gall bladder and this degenerated one.



Fig. 89

Left—Liver with enlarged gall bladder

Right—Liver with normal gall bladder

7th potency : If we look at the graph, we have a kind of maximum weight represented—but weight does not exactly mean health. It is just the same with a huge cabbage, produced with artificial manure ; it does not mean that its food value is excellent, and that it is good for people to eat these vegetables forced to grow excessively large.



Fig. 90 Post-mortem photo of mouse treated with 7th potency copper sulphate

Opening the body, we find that the tender skin which covers the intestines is infiltrated by parasites and the organs most damaged are the kidneys. They are both enormously enlarged. Fig. 92A shows a section through one of these organs to demonstrate the complete destruction of its substance.

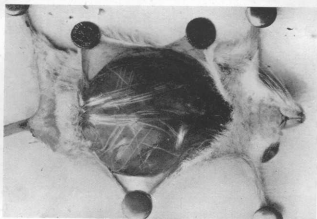


Fig. 91 Opened body of 7th potency mouse

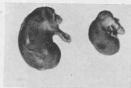


Fig. 92

The enormously enlarged kidneys



Fig. 92A

Section through this organ



Fig. 93 Liver and enlarged gall bladder. Mouse treated with the 11th potency of copper sulphate



16th potency : Nearly all the inner organs had suffered badly under the influence of this potency; the heart was damaged, the lungs partly inflamed and interwoven with hard nodules. The kidneys were normal, the liver enlarged, and the gall bladder enormous. Fig. 94 shows that the gall bladder nearly fills the whole space of the liver. It is still larger than the one we found in the mouse treated with the 3rd potency. The **spleen** is also enlarged.

Fig. 94 Inner organs of mouse treated with the 16th potency of copper sulphate

21st potency : This is an example of the shrinking of the kidneys. Sometimes both kidneys are shrunk; in this case only one shows this phenomenon exceedingly clearly.



Fig. 95 Mouse treated with the 21st potency of copper sulphate

Another example of shrunken kidneys is demonstrated in Fig. 96. This mouse had been treated with the 23rd potency.



Fig. 96 Mouse treated with the 23rd potency copper sulphate



Fig. 97 Mouse treated with the 24th potency copper sulphate, enlarged gall bladder



Fig. 98 Mouse treated with the 28th potency copper sulphate, enlarged gall bladder and tumours in the liver

It is remarkable to note, that **either** there is the **enlarged gall bladder, or the shrunken kidneys**. These two diseases never occur together.

These experiments seem to us quite convincing as to what happens if copper, even in a high potency, is taken for some time. On page 134 we gave a resumé about the views expressed by medical men concerning copper poisoning in human beings. The consequences are : liver shrinkage, gall-stones. Labourers in a vineyard who sprinkled the copper sulphate on the plants have kidney shrinkage and eczema behind the ears. The animals show pathological changes in the liver and kidneys, the cells are destroyed in these organs, according to the **accumulation of copper**.

Here science is wrong. It is not necessarily an accumulation of copper. It is not the substance in large quantities which causes the greatest harm—it is the “smallest entities” which we have been taught to neglect as harmless, which produce those terrible effects, because the **forces are stronger than the substances**. They are imprisoned in the solid matter, and the more we dilute, the more we free the hidden forces. We cannot see them, we cannot touch them, we cannot put them on the scales—but they act with deadly certainty.

We live in the age when everybody likes to speak about the “radiating forces,” about “waves,” “cosmic waves” and so on—and nobody doubts these—then why not acknowledge the fact that potentized substances are liberated forces, which can be studied as exactly as all other phenomena? If this fact were once understood then it should not be necessary to say much more about all those artificial manures, all those poisons we use so freely in farms and gardens, because the **quantity** of the poison used, **is so small**.

It is a crime against Mankind.

Experiment with Mice treated with "Uspulum"

Uspulum is used very frequently. It contains a certain amount of quicksilver and many farmers dip their grains in the dilution prescribed by the chemist, to protect the grains from diseases.

This experiment also started with the 3rd potency. Looking at the graph representing the weight of the mice treated with the different potencies, we find the first maximum arises earlier than with the silver or copper series. It occurs as early as the 5th potency ; after eight weeks' treatment as well as after six months' treatment, we find this potency indicated as a maximum in weight.

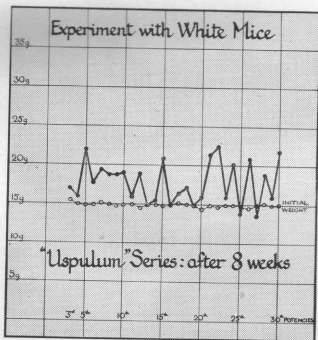


Fig. 99 Graph obtained for the weight of the series treated with Uspulum 8 weeks after the start

The second graph obtained after six months' treatment is clearer than the first one. The second maximum is the 17th potency (silver and copper had the 18th potency), but there is even a third, still higher maximum : the 28th potency. Perhaps we could also mark three minima : the 6th, 16th and 27th potencies. A certain inversion takes place. For instance, silver and copper have the 28th potency as a minimum, and here is a maximum.

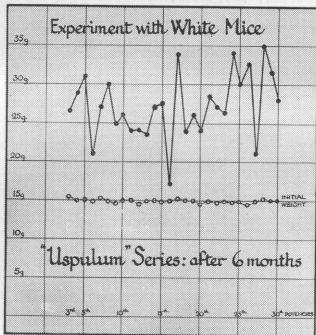


Fig. 100 Graph obtained for the weight of the series treated with Uspulum 6 months after the start

Figures referring to the above two graphs :

<i>Weight of Mice</i>						
<i>Starting the experiment with Uspulum</i>				<i>8 weeks later</i>	<i>6 months later</i>	
<i>Potency</i>		<i>grams</i>		<i>grams</i>		<i>grams</i>
3rd	...	15.5	...	17.0	...	26.5
4th	...	15.0	...	16.0	...	29.0
5th	...	15.0	...	22.0	...	31.0
6th	...	15.0	...	17.5	...	21.0
7th	...	15.3	...	19.5	...	27.0
8th	...	15.0	...	18.8	...	30.0
9th	...	14.7	...	18.8	...	25.0
10th	...	15.0	...	19.0	...	26.0
11th	...	15.0	...	16.0	...	24.0
12th	...	14.5	...	19.0	...	24.0
13th	...	15.0	...	15.0	...	23.5
14th	...	15.0	...	15.3	...	27.0
15th	...	14.8	...	21.0	...	27.5
16th	...	15.0	...	15.0	...	17.0
17th	...	15.3	...	16.5	...	34.0
18th	...	15.0	...	17.2	...	24.0
19th	...	15.0	...	15.0	...	26.0
20th	...	14.5	...	16.0	...	24.0
21st	...	15.0	...	21.5	...	28.5
22nd	...	14.7	...	22.5	...	27.0
23rd	...	15.0	...	16.0	...	26.5
24th	...	15.0	...	20.3	...	34.0
25th	...	14.7	...	14.0	...	30.0
26th	...	14.5	...	21.0	...	32.5
27th	...	15.0	...	13.5	...	21.0
28th	...	15.2	...	19.0	...	35.0
29th	...	15.0	...	16.0	...	31.5
30th	...	15.0	...	21.8	...	28.0

The quicksilver series produced quite different phenomena if we compare them with the two other series. The quicksilver affected at first the **skin** and the hair. The mice began to lose the hair on their heads, then along the spine, and later also on the abdomen. This began to be noticeable very early. Later, after eight to 9 months had elapsed, some mice started an inflammation of the eyes, at first only in one eye (usually the right), and then in both ; then the cornea was affected, and later still they became blind. It was very sad to look at all those little creatures which had lost their eyesight. About 75% of all the mice in this series became **blind**.

Reproduction was very poor. Litters were small ; sometimes there were only two young ones. Very often the young mice starved to death, because the female had not enough milk to feed them. So we did not succeed in getting a second generation from all the potencies, and had no third generation. The young mice very soon developed inflammation of the eyes. We give a few examples out of this series :



Fig. 101 Mouse treated with the 7th potency of Uspulum

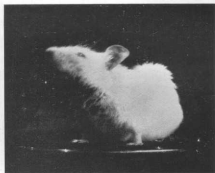


Fig. 102 Mouse treated with the 20th potency of Uspulum

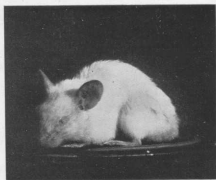


Fig. 103 Mouse treated with the 25th potency of Uspulum

The inner organs which were damaged by the various potencies were the **lungs** and the **liver**. But most injury was undoubtedly to the lungs. 80% of the whole series treated with quicksilver showed some lung damage ; at least there was in-

flammation of the lungs, but a large number had severe degenerative processes in the lungs. We illustrate our statement with a few examples.



Fig. 104 Treated with the 5th potency, liver and spleen enlarged, hard, entirely degenerated



Fig. 105 Treated with 13th potency, tumour in the lungs, spleen slightly enlarged



Fig. 106 Treated with the 25th potency, tumours in the lungs



Fig. 107 Treated with the 28th potency, liver and spleen degeneration

The study of those various poisons used abundantly in agriculture and their effects on animals, even in high potencies, is a sad chapter.

The so-called “**homoeopathic**” school of medicine has been in existence for many years. There are thousands of doctors who are convinced that remedies are more effective if used in high potencies. But they are not considered scientific. Homoeopathy has not yet been able to give ample proof that it is a “scientific system.” On the other hand, it is accepted as scientifically justifiable to say :

“ Poisons like quicksilver, or lead, or arsenic, are not at all dangerous in small quantities. All those deadly poisons we use as fertilizers or sprays are perfectly harmless, because the quantity is so small.” That is scientific.

In every field of life science meets with the problem of “ smallest entities.” The real trouble is, that our present science with its marvellous achievements, is more or less only **a science of the inorganic world**. We must again emphasize the need for a **Science of Life**. This science will have to deal with **forces**, with the **life force**, and has therefore to go a step further, from **matter to force**.

We sincerely hope that this book about the **Agriculture of To-morrow** will make clear to the public and the scientists, that a science of life has to be created for the sake of mankind. What we are doing now in agriculture will bear fruit later on. Our children and children's children will have to suffer for our mistakes.

Studying the effect of those minute quantities of substances which are abundantly used by farmers and gardeners in their effort to get bigger crops, or to prevent plant diseases, we come to the next problem : **Nutrition and Vitamins**.

NUTRITION AND AGRICULTURE.

The whole sphere of **agriculture** is closely connected with the problems of nutrition. For a long time, great stress has been laid upon the **substantial** part of the foodstuffs. The nutritive value has been considered as equivalent to the matter of the foodstuffs. This is just the same as the prevailing idea that in farming and gardening the most important part is to feed the plant, and that everything depends on the **substances** which are in the soil. Many of the agricultural methods of the last decades have been born out of this idea—that one has to feed the plant, and that certain substances have to be introduced into plant life. The plant has been looked upon as the result of the various substances with which the plants have been fed.

Plants have a quite different source of nourishment from that of animals. The plant takes the greatest part of its nourishment from the air, not from the soil. The plant assimilates, transforms, the carbonic acid of the atmosphere, so that the carbon substance of the plant is formed. From the soil the plant takes the salts and a few other substances, connected with animal manure. But the greatest amount, especially everything that has to do with the plant-nature itself, with the green pigment of the leaves, all this is taken from the air. We owe the oxygen of our atmosphere, the possibility of our breathing, entirely to the plant kingdom. Our oxygen atmosphere has only arisen because whole vegetations were submerged when the land subsided, and buried beneath a mass of sand, to be transformed—millions of years ago—into carbon. Carbon has been deposited in the depths of the earth and the oxygen has been freed.

We can say that we owe our oxygen atmosphere on the one hand, to the plants, and on the other hand to another substance—**calcium**. Calcium absorbs carbonic acid, so that we do not suffocate.

We have already pointed out that the plant is built up only to a very small degree from those substances which it takes out of the soil; plants take their food largely from the surrounding atmosphere, the air. We have also pointed out, that the process of taking carbonic acid out of the air, is closely connected with **light**. So we can say that a large proportion of the substances which feed the plants is light, and all that is connected with it that is streaming into the plants. The process of assimilation and of taking foodstuffs out of the air, with the help of chlorophyll, may indicate, that there are two factors collaborating together. The one factor consists in the material, the substances, and the other factor is all that comes into the plant with the light out of the universe. We have to look at plants in such a way that we learn to recognize these two different processes. On the one hand there is the seed embedded in the soil, developing its roots, taking in the salts from

the soil. On the other hand the plant is sprouting towards the light. Two opposite forces are acting, the one coming from the earth, the other coming from the cosmos. From the earth come the substances, from the cosmos the forces. Studying plant life we shall always have to reckon with these two entirely different forces; and many things which seem so problematic to-day, have become problematic because we do not like to acknowledge that there are two different forces acting in plant life: those connected with the earth, with the forces of gravitation, the more material forces; and those which are streaming in from the universe, having light as their foremost representative. Of course there are many other things streaming in from the universe with light, chemical and other manifold influences.

In respect of the **food-value** of the plant, much more depends on these cosmic forces, on how the plant is building up its whole life process, than on the substances themselves, because this fact also determines how the plant absorbs the food.

We can never assess the values of human food merely from scientific considerations. If, for instance, a person's food does not contain any living vegetable matter, or if it makes no appeal to his sense of taste, and so does not interest him, or give him pleasure and thereby affect him psychologically—then the food does not really nourish him. The food may have been prescribed for him scientifically, but it will not nourish. It is similar with plants. They do not take from the soil all the substances we have put into it, unless we first take care that they have the requisite strength to absorb them.

The forces which enable the plant to take up the various substances, are different from the substances themselves.

Experiments have been made by growing plants in a variety of nutritive solutions, to find how much of their ingredients the plant needs. Our whole method of manuring, of using artificial fertilizers, has been built up upon the idea, that everything depends on the substances used. Nevertheless, the question of the **vitamins** arises. Something of the fresh and living plant must be present. We need the **forces** and not the substances. Certain forces are needed by man which will make him assimilate the food. He requires living substances so that he may transform them, destroy them, according to his individual strength. The foreign life, entering the human body, acts upon him in such a way, as to stimulate the digestive process.

There is no method existing up to the present, which would enable us to find the food value of agricultural products.

To-day, farmers are only anxious to increase their crops with the help of fertilizers. The aim is to produce more material, more substance. But nobody has tried to discover what happens if these products are then used for human food. It is because we only think of matter that no one has ever undertaken to look for food-value in other qualities.

For instance, **electricity** may be used to increase our crops. Electric light, or electric heat make the plants grow more quickly, and bigger crops result. Certainly that is of economic value. But we should think what it means when the plant is

forced to grow much more quickly, to ripen much earlier, so that whereas in the natural course the plants accomplish their flowering and fruiting and ripening once, with the help of electricity they will now complete this process twice in the same period. They are emancipated from the seasons, emancipated from the sun. We do not consider such subtle differences, because we are convinced beforehand that what streams in from the universe can easily be compensated for by earthly forces. We believe that electricity can do the same as the sun. But in reality these are two entirely different forces. Electricity is more connected with the depths of the earth. The forces of electricity—if we could not isolate them—would always stream into the soil. They belong to the earth. If we use electricity, we use the counterpart of light. From an external point of view, light is present in both cases; only these two lights are entirely different in origin and effect.

If we were to experiment with plants grown under the influence of electric light, we should find that they have a different food value. The real food value depends upon forces streaming in from the universe, bringing **life** to the plant; electricity always acts in a contrary manner—against the normal processes of life.

It was stated that it is possible with the help of ultra-violet rays to get three harvests in one year. If cabbages have been grown in a third of the usual time needed for a cabbage to grow, then something must have been lost—namely something of its quality. The plant can only develop its full life-process, if it is placed rightly in the rhythm of the year and of the seasons. Nothing can take the place of this. Flour, for instance, treated with ultra-violet rays, can never be a substitute for the true living quality of the natural product, which is by no means merely the summation of its chemical constituents. It consists of the forces of life.

Therefore, in farming we must take into consideration that the plants are not only the result of earthly forces, but also of all those forces which emanate from the whole cosmos. Here we are at the very beginning of a new science. Chemical elements are not present only in the foodstuffs, they also radiate everywhere, and are present in the light. There are nearly as many different kinds of light-radiations as there are substances. In **rickets** light is of the utmost importance. If babies are in dark rooms their bones cannot be formed in the right way. It is just the formation of the bones, indeed the formation of the whole body, that depends not so much on the substances themselves, but on the influences which stream in from the cosmos. In the periphery **silica** is highly active. It acts on the skin, in the hair, in the sense organs, where silica is even present as substance. But the substance itself is not the important part; what is really important is **silica-metabolism**. This is a living process and through this process form is created.

It is just the same with the earth as a whole. The earth has an immense silica mantle. Silica is always on the periphery; even in microscopic small objects, in cells, we find it in the outer membranes. In Nature we see silica forming the most beautiful crystals. Rock crystals are perfectly transparent; but considered as substance, silica is inactive. Therefore silica has not been taken into serious consideration for a long time, although it has been used in homoeopathy and becomes

active in homoeopathic preparations ; only then it is no longer present in substantial quantities. Silica plays a great part in the plant kingdom, where it acts as a kind of collector for all those forces which stream in from the cosmos.

On the other hand if we study **calcium**, we find that this substance always withdraws into the inner parts of the body. Lime provides the human being with his skeleton. Compared with silica, lime is a more earthly substance. It is a great pity that the modern science of chemistry makes no such subtle discriminations between earthly and cosmic substances. We find both on earth, and we find both in the stars ; therefore, we tend to bring them both to the same level. But they have quite opposite effects, according to the realm from which they are derived.

In Chapter VI when dealing with the influence of light and darkness on plant growth, we pointed out already that silica plays such an important part in plant life, and that it mediates a certain **light-metabolism**. If silica is present in the soil, then the plants can make better use of the light beneath the surface of the soil. It is much more important for their healthy growth that there should be a certain amount of silica in the soil (which helps the plant to collect all the cosmic forces) than to add artificial fertilizers, which they cannot assimilate—just as the nourishment which is reckoned out for human beings according to its caloric value does not really nourish them.

It is necessary to have agricultural methods which will ensure that the agricultural products are still real plants. To-day we sometimes get vegetables which still look real enough, but they no longer carry cosmic forces within them.

The question is—how can we find the right method in farming and gardening, so that the plants retain their original cosmic qualities instead of growing huge cabbages filled with chemical fertilizers only ? How is it possible to have agricultural methods which take into consideration that plants are only real plants if we do not rob them of those subtle forces which stream into them from the whole universe ? We cannot substitute ultra-violet or other rays for the life-processes.

It is very generally supposed that the active part of cow manure consists in the different mineral salts which it contains, and that therefore it is possible to substitute mineral salts for cow manure. But it is essential for the plant to be in inter-relation with animal life. The **nitrogen** contained in animal albumen plays an important part. Nitrogen is a substance which is found in the atmosphere in large quantities—but there it is usually inactive. Under certain circumstances this natural nitrogen may become active. For instance, in the animal body it is immensely active, always in movement, always entering into chemical compounds, or if there is a thunder-storm, and the lightning flashes, the rain which pours down contains nitrogenous salts. So what usually takes place as nitrogen activity in the animal body, now happens as a cosmic process. Hence rainwater acts as a manure for the plants.

If we add animal manure to the soil, we complete a certain circulation between the plant and animal kingdoms. The plant takes its nourishment out of the soil from below, but gets its life-forces from the substances which have passed through the animal metabolism.

Thus there is always an interplay between plants and animals. The leguminous plants take the nitrogen directly from the soil. We use them again for green manuring—they have certain qualities which we may compare with those of animals.

Above, the animal eats the plant ; and below, the plants eat the animal manure. That is a circulatory process. We cannot make a substitute for this living circulation by separating the salts. We say the plants use potassium nitrate. But take **only** potassium nitrate and feed the plant with it. Does the plant like to absorb the pure potassium nitrate? Does it develop the same appetite for the mineral salt as it develops for the whole living process?

It is important for plant life to come into contact with animal manure. What is manure for the chemist? A conglomerate of many substances. For the chemist only those substances are pure which have undergone chemical analysis. Everything else is a compound. This is, of course, correct for the chemist who makes experiments in test-tubes. But in the realm of Nature we must say that such a thing as "manure" is, in the organic world, much simpler than the different constituents which we separate out of the manure by chemical analysis.

We say that albumen is the most complicated substance, and it certainly is so according to chemical analysis. We can try to build it up, we can come very close to it—but we can never make it. Albumen is that substance where chemical science comes to an end. There are **forces** in the albumen, which escape chemical analysis. But from the point of view of "life," albumen is the most simple substance. It is everywhere in protoplasm and biologically entirely simple. If we kill it, if we begin to analyse it, then we are faced with something enormously complicated.

Is not manure an entity in itself, for which we can never create a substitute with an artificial conglomerate?

We can never substitute for the food value obtainable from the living product, the summation of its chemical constituents.

Chapter XVI.

WHAT ARE THE VITAMINS?

The modern theory of nutrition entered a new phase of development when, about twenty years ago, the so-called **vitamins** were discovered. We cannot assume that every reader of this book is thoroughly acquainted with these facts, so we include a few introductory remarks about vitamins.

There were certain diseases which had puzzled scientists for a long time. It was not quite clear whether these diseases were caused by some specific bacteria, or whether there were other causes, for instance, a one-sided nutrition. People who for a long period had nothing but meat to eat, especially tinned meat, developed **scurvy**. The symptoms of this disease are well known: a general weakness of the muscles, haemorrhage, general emaciation, the skin becomes pale and loose, a great decline of vitality sets in, which may become fatal. This extremely dangerous

illness can quickly be cured, if the patients have even small quantities of fresh vegetables, or fruit juices, lemon juice or orange juice. But it is essential that the juices should be fresh.

Another similar illness occurs especially in Malay, the Dutch East Indian Colonies and in China. The symptoms of this disease, the so-called Beri-Beri (or Japanese "Kakke") are general exhaustion, decaying muscles, swelling of the limbs, and complete lack of resistance in the organism. Paralysis due to the decay of the muscles sets in. The Beri-Beri disease attacks people who live more or less exclusively on polished rice. Experiments were carried out, a number of persons being fed on polished rice, while others had rice with the skin. All those fed upon polished rice contracted Beri-Beri disease. They could be cured with a decoction of the rice skin. So it became clear that this disease was entirely due to certain nutritive substances in the skin of the rice, or very close underneath the skin, which are lost through the polishing process.

Again, a similar thing happens in districts where the population consumes large quantities of maize. If the maize is skinned, the **pellagra** disease occurs. The symptoms of this disease are also very characteristic. At first there are slight attacks during spring and autumn when people show awkwardness in their movements, and have a characteristic way of walking. Then they begin to complain of headaches, dizziness, sleeplessness, weakness and neuralgia. Later they lose their appetite, sometimes they have a strong aversion for the accustomed food, then again they have a ravenous appetite. The tongue becomes inflamed, excessive salivation sets in; the patients are thirsty, they have stomach-ache and often diarrhoea. It is clear that there is complete disorder in the metabolic system. This disease can also be cured by giving maize which has not been skinned.

After some time it was stated that this applies to all cereals, because just underneath the skin substances are concealed which are vital for nourishment.

The same applies to the skin of oranges and lemons, etc. Each living organism isolates itself from the surrounding world with a skin or shell; just there, where the life-process is gradually entering the mineralized part on the periphery, something is deposited which contains an enormous intensity of vital forces, on the borderline between the organic and inorganic.

Starting from this point, many experiments have been carried out to isolate these substances, because our modern physiological chemistry is always seeking for the causes of these particular effects. Even to-day we are still inclined to attribute the effect of a remedy belonging to the plant or animal kingdom entirely to the sum of its chemical constituents. It is sought to find the essential thing which is responsible for the cure in a single chemical substance. The effect must, as it were, cling to some material particle.

Everything has been tried in order to discover these substances, and to isolate them from the various plants which show these specific properties. It is strange that sometimes only the most minute amounts are sufficient to restore health. **The**

quantities are really so small that one can realize how strong is the contrast between the substantial effect of foodstuffs and this remedial effect. Those substances which it was hoped to isolate, are called **vitamins**.

Many years have passed, and therefore we can review some of the results of these endeavours. More and more vitamins have been found. But there are four especially important ones: vitamins A, B, C, and D.

The attempt has been made, therefore, to isolate from fresh plants, especially from green leaves and fruit juices, something which still contains the essential properties of these fresh vegetables or juices. This has been called Vitamin C and is able to cure scurvy.

What is hidden in the skin of all cereals, lemons and oranges, has been called Vitamin B. It cures Beri-Beri disease.

Another illness is rickets. It is well-known that this illness also has something to do with nutrition. It occurs when the skeleton is being formed, when the bony system begins to develop in the first and second years of childhood. Rickets occur within a certain age limit and during this period substances contained in animal fats help, for instance cod liver oil, or other things containing phosphorus. In these is the Vitamin D.

In animal fats, in butter, milk, and in the yolk of eggs, there is a substance which is especially connected with growth and with the warmth-process in the human organism. If this substance is not present, growth cannot develop in the right way and the warmth of the organism is disturbed. That substance is Vitamin A. It has a great resistance to heat. Usually the vitamins are very sensitive to heat. If we heat foodstuff more than 70°C . the vitamins are destroyed. But vitamin A is not so sensitive to the higher degrees of warmth. Recently more and more vitamin-like substances have been found. It is not quite correct to say "substances." It is not possible to produce such a substance, in the same sense in which we usually speak of producing chemical substances.

If we produce a salt or some other chemical substance we know perfectly well what we have created. We know that it has a certain melting point, boils at a certain temperature, has a certain form when it crystallizes. There are qualities we can define. It is not so with the vitamins. We can try to extract them from animal fats or green plants. But in doing this the life of the organism is lost. Isolation of these vitamins has been tried, but it has never been possible to produce a vitamin in the same sense that we can produce other chemical substances. **We should say therefore, that the vitamins are not substances.**

The theory of the **calories** rightly starts from substances, since these play a part in nutrition. But in the effect of the vitamins we have something which is in direct contrast to the material effect. Once a comparison was made between food taken directly from the plant kingdom, and the same thing artificially produced in the laboratory. One may take the same quantity of substance and it may have exactly the same caloric value, but if a human being eats the chemical product it

has no food value at all, and after some time the symptoms of scurvy appear. The same happens if we eat tinned conserves which no longer possess those vitamins. If we plan our nourishment thinking that the nutritive value is equal to the sum of the various chemical ingredients, then it happens that after some time we are compelled to add the real nutritive values in small amounts in the form of vitamins.

Chapter XVII.

FERMENTS.

A similar phenomenon is found in another sphere of physiology. When digestion takes place, various digestive juices must be produced by the organism. We know that there is hydrochloric acid in the stomach and another substance we call **Pepsin**, a ferment. The question arises: "What is a ferment?" Just as we had to ask "What is a vitamin?" so we have now to ask, **what is a ferment?** A ferment is only present in very small quantities in something that is living, and has the capacity of starting certain reactions, for instance, the process of fermentation of yeast. Wherever yeast is added, fermentation begins. For many, many years scientists could not make up their minds whether fermentation is something material, or an effect of life. A great French scientist held the opinion that it is an effect of life, others had different opinions, that it is only something material.

To-day we can make Pepsin. We take some gastric juice and add alcohol. A deposit is produced, which is more or less albumen. The deposit is dried and purified, and at last becomes a white powder. This white powder is nothing more than a somewhat transformed, dried and purified juice from the stomach. Of course we must be careful not to change it too much in preparation, or it becomes inactive. We can dissolve some of this white powder in water, add one drop of hydrochloric acid and some of the albumen of an egg. The albumen dissolves, it becomes "digested," although there is no stomach there. **The digestive power of the stomach has been isolated.** That is the ferment which is called Pepsin. But that too is a substance which we cannot quite understand chemically. It is the living function of the stomach which still clings to its material bearer.

Everywhere in nature we find such ferments. The pure chemical substances are absolutely dead, and they can be isolated. The ferments are not such chemical substances, they are always connected with some living organism; plants, animals, or the human being. There are nearly as many ferments as there are substances. There is one branch of science which is only dedicated to the study of fermentation. Nothing would function in a living organism without the collaboration of the ferments with the different substances. For instance in the stomach, the ferment acts with hydrochloric acid.

In the pancreas there is again another ferment active: **Tripsin**. Whenever we have a chemical substance, we know exactly what this substance is, we know all its qualities, etc., but a ferment is nothing else than an expression for a specific function of life. Everything arises out of the collaboration of such life-functions with chemical substances. That is very similar to the vitamin-problem.

Everywhere in the inner organism there are ferments ; and just as the summation of all the chemical substances represents the material body; the summation of all the ferments represents the unity of all the life processes.

In Pepsin there is still a part of the stomach which is able to digest, although not so strongly as the stomach itself can digest. It has retained part of the living organic functions. Each organ, each juice has another function.

The vitamins are similar. We cannot produce them as we can other chemical substances. The vitamins that we can buy are similar to ferments. Something has been extracted very carefully from the life-process of plants. The effect can be increased according to the quantity, condensing what is distributed in Nature among many plants. There is a different life-process in the leaves, fruits or roots. But the vitamins are treated as other chemical substances, and we want to feed human beings with them. Some time ago everything was estimated according to its caloric value; now the same thing is done with the vitamin-contents, which are introduced everywhere as foods. They are regarded as material substances.

Another scientific opinion is, that vitamins are identical with specific radiations. It has been found that in treating milk, or butter, or flour with ultra-violet rays, similar effects are produced as with vitamins. Some people think it is not necessary to have vitamins and that foodstuffs treated with ultra-violet rays may be substituted for them. In recent years many food preparations have been sold to the public which have been so treated. For instance, one such preparation was called "Vigantol." At first everybody recommended it, then it was violently rejected. It was found that vitamins could also act as poison. Because it is assumed that vitamin is a substance plus ultra-violet radiation, it is a great mistake to substitute chemical matter treated with ultra-violet rays for the living plant organism. If to-day one reads an advertisement of vitamin preparations, one does not know what one is really buying. It may be only some substance treated with ultra-violet rays. Although it is introduced to the public as food—in reality it has nothing whatsoever to do with human nourishment.

Sometimes such "foods" may at first cause a certain increase in vitality, and later on the opposite thing occurs—sclerosis. The bones become brittle, etc. The same is the case with radium or X-rays. They have an effect on the life-process—but it is very difficult to find the right quantity to administer. That is easy to understand. We may know how much to administer of a substance ; it is much more difficult to find the right quantity of a radiating energy—it may act in a manner quite contrary to our intentions. We are not working with life-processes in such a case, but with radiations—something emanating from decaying substances.

Science has discovered vitamins—but this has not helped towards an understanding of the vital processes in Nature. It has only led to the isolating of these vitamins ; to considering them equivalent to other substances ; or to considering them as substances plus radiations. It would not matter so much, if we did not feed mankind with these dangerous preparations.

It is astonishing how many things the public can obtain which are dangerous to handle. Everybody is convinced that radium or ultra-violet rays are excellent things. Many people possess lamps emitting ultra-violet rays and they regularly treat all their children with them. More and more people are buying these lamps, but do they really know what force they are using?

In buying salt—one is not always sure that it does not contain iodine. Iodine is a very effective substance in the hands of a doctor—but should it really be used freely by the public?

We buy foods, and are told they have been treated with ultra-violet rays, and that should mean that they are rich in vitamins. Are they really richer in life forces? Or is the contrary the case? Ultra-violet rays have nothing whatsoever to do with original vitamins—the life-force hidden in the fresh plants.

We need a new science which will be able to tell us about substances. If we are convinced that matter is the only important entity, and neglect the wide realm of forces, we make serious mistakes.

Take, for instance, a substance like citric acid. Citric acid is found in Nature in lemons, 7-9%, and in other fruits in a lesser degree (red currants, bilberries, gooseberries, sugar beet, sugar cane, etc.). Citric acid can also be bought from a chemist in the form of white crystals. It might be made from lemon juice, but it could also be made synthetically from acetone, or with the help of some bacteria. Lemonade can be made either from a real lemon, or from a few crystals of citric acid. Is there any difference between these two lemonades? Both contain citric acid—but the one comes directly from the fresh fruit, the other is extracted by chemical methods from fruits, or built up synthetically. The one may contain the so-called vitamins, the other not. They have nearly the same taste, provided the same degree of acidity is in both lemonades. We need to have a good sense of taste to be perfectly sure which of the two juices is the fresh lemon juice. How can we find out if there is really a difference between these two forms of citric acid?

Chapter XVIII.

CAPILLARY DYNAMOLYSIS*

In the Biological Institute at the Goetheanum (Stuttgart) we have developed a specific method of research, which enables us to find the various **forces** hidden in substances, just as "Vitamins" are hidden in fresh vegetables or fruit. We call our method: Capillary Dynamolysis. It is based on the same principles as Capillary Analysis. Since we cannot presume that every reader is familiar with this scientific method, we will give a few historical facts.

The phenomenon of capillary attraction was mentioned in the fifteenth century by Leonardo da Vinci, the great painter, who was at the same time a great architect, sculptor, musician, and scientist.†

* Circumstances compelled me to make an advance print of this chapter in 1943. For the sake of completeness we reprint it in this book, and add some more experiments.

† *Histoire des sciences math. en Italie*, III 54.

The first scientist who studied this phenomenon was Niccolo Aggiunti (1600—1635) Professor of Mathematics at the University of Pisa. He found out that liquids rise in capillary vessels.

Much later, in the second half of the 17th century capillary attraction was studied more thoroughly by a member of the Academia del Cimento, Giovanni Alfonso Borelli. Still later we find publications by Laplace (1805), Th. Young (1805), Gay Lussac (1808), Gauss (1830), Quinke (1858), Mendelejeff (1860), Rontgen (1878) and many other well-known scientists.

Capillary attraction is the process of a liquid rising in filter paper or any porous medium (e.g., a liquid rising in a sponge, or sugar; paraffin rising in the wick of a lamp). We find this phenomenon prevailing everywhere in nature. The soil takes in water through capillary attraction; the sap of plants or trees rises in all the vessels through capillary attraction, and in animals and human beings the blood circulates through capillary vessels.

It has been found, that each substance has its own rising limit. Water rises in filter paper to a certain height. Alcohol has another rising limit. Plant juices, according to their viscosity, again have various rising limits (of course, the temperature and humidity of the air has always to be taken into consideration). It is not possible to go into details about the phenomenon of capillary attraction in this book. We merely want to mention it for the sake of explaining our method of Capillary Dynamolysis. This is a new term which we are introducing, and it may seem complicated, but, in reality, it is quite simple if one understands the meaning.

Well known is the method of capillary analysis. Owing to the fact, that each substance has its own rising limit, it is possible to analyse mixtures with the help of the phenomenon of capillary attraction. If we study, for instance, the careful investigations carried out by Friedrich Goppelsroder (Capillar-analyse, Basel 1901), we find that he uses for a capillary medium strips of filter paper. The juice of the roots of a grass is extracted with alcohol. The filter paper is dipped in that extract, and the liquid begins to rise. After some time the limit of rising is reached, and when the paper gets dry it is possible to distinguish differently coloured zones. Then Goppelsroder takes the measurement for each zone and ultimately describes the result obtained:

<i>cm.</i>	
2.5	colourless
0.5	yellow
2.3	colourless
0.37	brown
0.4	light brown
0.4	nearly colourless
0.1	brown
0.15	light brown highshine
0.1	brown
2.35	brown highshine
0.35	brown

Total 9.52

Mixtures of colours, or urine may be treated in a similar way. The different substances present in the urine are deposited in different zones in the filter paper according to their rising capacity. It is, of course, very interesting to make these tests, and many useful details may be found. But in all these tests we have to deal with a purely physico-chemical analysis. The scientist only looks for the substances in using capillary analysis.

We use the same principle that liquids rise in filter paper, but we want to study the forces acting in the various substances. We want to look behind the veil of matter.

We will try to explain what we mean, with an experiment carried out with lemonade :

- (a) with the juice of a fresh lemon
- (b) with citric acid dissolved in water.

Both liquids contain the same amount of citric acid.

In a glass dish containing juice (a) and in another glass dish containing juice (b) we dip filter paper folded cylindrically. The width of the filter paper is 10 inches, the height 14 inches. Both juices rise and reach approximately the same rising limit. The paper remains colourless, the border lines are scarcely to be seen. Looking at these two filter paper tests, we cannot discriminate between the fresh lemon juice and the citric acid solution. The only possible difference to be found in this test would be in the eventual difference of the rising height.

If we taste juice (a) and the solution of citric acid (b), our sense of taste can also scarcely differentiate between them, and still we know that there exists an enormous difference : the one is derived from a fresh fruit containing the precious vitamins, and the other is made in a laboratory and can originate from various sources.

We proceed to the second half of our experiment. After the filter paper is quite dry, we add a metal salt—nitrate of silver in a solution of 1%. The experiment has to be made in daylight. There must be sunshine, but not too bright. The citric acid reduces silver nitrate and is helped in this process by light. The filter paper which has been penetrated with the real lemon juice begins, after 10 minutes, to get yellow. The silver nitrate is rising and in the rising process beautiful leaflike structures appear, as if they were engraved with a pencil in the paper.

The second experiment where the filter paper has been dipped in the citric acid solution, shows that the silver nitrate rises in the same manner—but no yellow colour appears. After a long time we may find that there are some forms engraved there also ; the colour is greyish-black. The formation is weak in comparison with the other test, which now bears a brilliantly yellow-brown coloured picture. The photos reproduced here in Figs. 108 and 109 (see page 169) convey only to a small extent the beauty of the original experiment.

These two pictures reveal something of the inner force, the inner life of these two lemonades. Of course we cannot sufficiently describe the pictures with figures ; it is no use to measure or to count ; either we realize the living plant force in the

one, and the lack of this force in the other, or we do not realize it. We must learn to read these experiments. It is a very real script which Nature places before our eyes.

Fig. 108 Experiment with citric acid followed by 1% silver nitrate

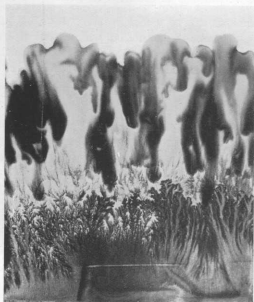
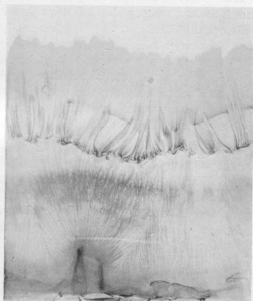


Fig. 109 Experiment with lemon juice followed by 1% silver nitrate

Mixtures of colours, or urine may be treated in a similar way. The different substances present in the urine are deposited in different zones in the filter paper according to their rising capacity. It is, of course, very interesting to make these tests, and many useful details may be found. But in all these tests we have to deal with a purely physico-chemical analysis. The scientist only looks for the substances in using capillary analysis.

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Both liquids contain the same amount of citric acid.

In a glass dish containing juice (a) and in another glass dish containing juice (b) we dip filter paper folded cylindrically. The width of the filter paper is 10 inches, the height 14 inches. Both juices rise and reach approximately the same rising limit. The paper remains colourless, the border lines are scarcely to be seen. Looking at these two filter paper tests, we cannot discriminate between the fresh lemon juice and the citric acid solution. The only possible difference to be found in this test would be in the eventual difference of the rising height.

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Fig. 110
Rhubarb Juice preserved



Fig. 111
Rhubarb Juice fresh

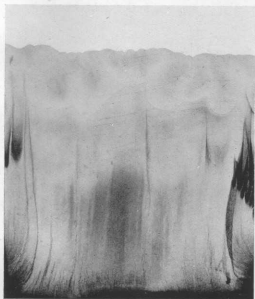
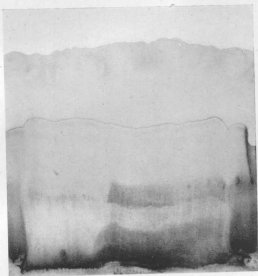


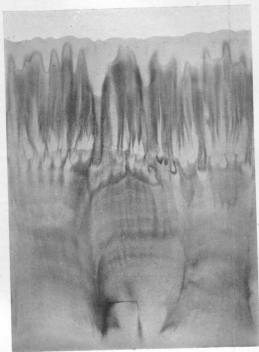
Fig. 112 Preserved Rhubarb Juice
followed by 1% silver nitrate



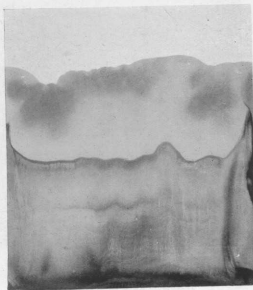
Fig. 113 Fresh Rhubarb Juice
followed by 1% silver nitrate



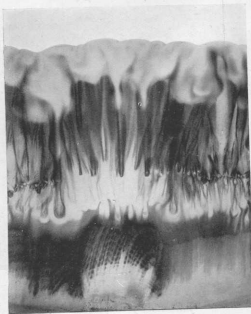
*Fig. 114 Preserved Rhubarb Juice
followed by 1% gold chloride*



*Fig. 115 Fresh Rhubarb Juice
followed by 1% gold chloride*



*Fig. 116 Preserved Tomato Juice
followed by 1% gold chloride*



*Fig. 117 Fresh Tomato Juice
followed by 1% gold chloride*

The fresh juice is slightly pink, the border line is clearly visible, the rising limit is 12.5 cm. The preserved juice is clear yellow, the rising limit is 11.5 cm. ; still there is not much difference between the two pictures before adding the metal salt. After the addition of the silver nitrate we notice again a vivid yellow brown colouration in the picture forming itself together with the fresh rhubarb juice ; and a pale yellow and grey colour in the preserved juice.

The finished experiment reveals a strong radiating force in the fresh rhubarb juice (Fig. 113) which is completely lacking in the preserved specimen (Fig. 112).

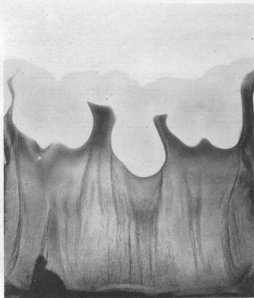
Many control experiments are carried out with various other metal salts, but we are unable to reproduce them all. For example the experiment with gold chloride is very instructive for the rhubarb juice.

The beauty in experiments carried out with gold chloride is due to the manifold colouration in the first place. The preserved juice produces a rather dull picture, more or less uniform slightly yellow, with horizontal purple lines. The fresh juice is entirely worked through with mauve and purple shades, and shows a similar radiating force permeating the whole picture. (See page 172, Figs. 114 and 115).

The same test carried out with fresh and preserved tomato juice is also very interesting. (See page 172, Figs. 116 and 117).

It is easily seen, that the fresh tomato juice is full of life, and the preserved one nearly lifeless. Furthermore, if we compare the test of the prepared rhubarb juice with the test of the prepared tomato juice there is a great similarity between these two pictures. It is our opinion that the similarity is due to the method used for preserving. It is very likely that the preservation has been carried out with electricity.

Even more striking is the contrast between the tests where we use an addition of silver nitrate.



*Fig. 118 Preserved Tomato Juice
followed by 1% silver nitrate*



*Fig. 119 Fresh Tomato Juice
followed by 1% silver nitrate*

Silver nitrate brings out the full development of the forces working in the fresh tomato juice. It is a coarse and undisciplined force which is revealed in these experiments. That force has been killed with the preserving. The juice still tastes like tomatoes; only to a schooled sense of taste, there is a certain quality behind it, which makes it dull. Of course there is still the question left open: should the tomato fruit be used so freely as a "refreshing drink"? Does the human organism agree with it? Tomato cocktails are more and more frequently asked for. Very often these cocktails are made from the fresh fruit, so that the full strength of this plant enters the human organism.

Some years ago a scientist made experiments with rats. They were fed with tomatoes, and, after some time, ulcers appeared. The scientist spoke of carcinoma or sarcoma. A short time after the contradiction came from the business man. Of course it cannot have been cancer, it must have been something entirely harmless, because tomatoes are so refreshing, and an excellent food.

It would be worth while to investigate further into this matter.

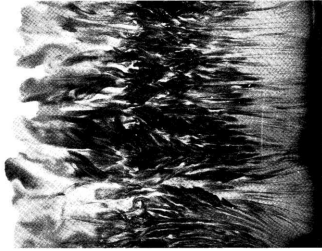
Chapter XIX.

Practical Application of Capillary Dynamolysis in testing various methods of fruit preservation

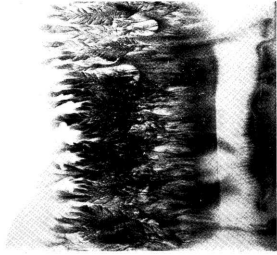
Some years ago we made experiments in trying out the various possibilities of Capillary Dynamolysis. A great business concern which specializes in apple and orange juices sent us some bottles containing apple juice treated with various methods of preservation. The bottles were numbered 1, 2, 3, and we were to tell with our method, if there were any differences in the three bottles, and which one we found the best.

At first we tasted the various juices and made notes of our observations. Then we invited friends, adults and children, to taste and give us their opinions. All of them decided that number "3" did not taste at all pleasant; number "2" was good, and number "1" was between the two others.

After this we started with the Capillary Dynamolysis using additionally metal salts: silver nitrate, gold chloride and others. For objective control purposes we also used the juice freshly pressed from an apple. The result is represented in the four following photos.



*Fig. 120 Juice of fresh Apple.
Followed by 1% silver nitrate*



*Fig. 121 Bottle "2" which we found
best. Followed by 1% silver nitrate*



Fig. 122 Bottle "1" which we found next best. Followed by 1% silver nitrate



Fig. 123 Bottle "3" which did not taste pleasant. Followed by 1% silver nitrate

The pictures obtained by our method reflected what we had tasted. The juice we liked best, had preserved much from the original apple forces. The fresh juice is more penetrated with life, the forms are like flaming torches, and the colours of the original lively yellow-brown.

Bottle "2" has, in a certain way, the same forming tendency, only it looks somehow frozen, finer, thinner, a little less lively and the colours are not so glowing.

Bottle "1" shows, in the lower part of the test, some leaf-like structures, but the rest of the picture is rather heavy and chaotic. If we compare this with the fresh juice, it seems that some harm is done to the life force of the apple.

Bottle "3" is perfectly destroyed as far as life is concerned. At the bottom of the picture we recognize that some effort has been made to form leaves, but all the rest is overpowered by a formless mass of brown and brown-green spots. The original formative force of the apple is destroyed. There is no life left in this juice. It cannot be recommended as a beverage, from our point of view.

We sent our report to the manager of the concern in question and asked for information about the three methods of preservation used by them.

He replied that bottle "1" had been preserved by heat, bottle "2" with cold (it was a special new process, freezing out the water content, which could not be explained in detail to us, being kept as a business secret.) Bottle "3" had been preserved by electricity.

The chemist of this concern rejected our opinion that the juice treated with electricity was the worst. He thought from a scientific point of view, it must be the best. Neither heat nor cold would influence the juice so homogeneously. The electric current passes through, and the whole juice is sterilized. It may be sterilized, we do not doubt this. We also do not doubt that the electric current really touches every atom of the juice, and transforms it in a homogeneous way. Only it also kills the life force completely.

We are convinced that this method of Capillary Dynamolysis is able to solve many problems concerning the value of food. But it can only be handled by an expert who has been trained for years in the various fields connected with this subtle test.

It is impossible to give in this short introduction to a new sphere of scientific research, a complete picture of the manifold problems which may find solutions. We must limit ourselves here to a few examples. More will be found in the various chapters of the book dealing with agricultural problems, and much of our research work will have to wait for later publication.

Another interesting problem arises, for instance, if we have to use a substance for remedial purposes. Can we replace the natural substance with the synthetical one? This leads to the next chapter.

Practical Application of Capillary Dynamolysis : The difference between " natural " formic acid and " synthetic " formic acid

We have studied this problem thoroughly, but can give here only one example.

In the case of lemonade with fresh lemon juice, or citric acid, we have seen, that the fresh juice contains life forces, while the pure citric acid is more or less devoid of life forces.

We proceed from plants to animal excretions. Formic acid is excreted by ants naturally, or it can be made artificially in the chemical laboratory. Both liquids are formic acid; both have the same chemical formula, only the one is chemically " pure " the other is " natural." It was not easy to find the right kind of experiment for these substances, but after some time we succeeded.

Silver nitrate and gold chloride cannot be used for this test in the same way as for plant juices. Of course we can let formic acid rise in the filter paper and then, later on, add the various metal salt solutions, only the result is not characteristic enough to enable us to form a clear judgment.

The best method for formic acid is to use a mixture of silver nitrate and iron sulphate. These two metal salts are used in a concentration of 1%, mixed in equal quantities and filter paper is dipped in. The result is fascinating; 10-15 minutes after starting the experiment, the formation of tiny black spots sets in. These spots grow to little arrows which seem to fly in from various directions of space. Fig. 124 represents this type of experiment.

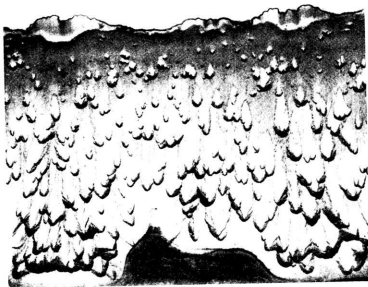


Fig. 124 1% Silver nitrate and 1% iron sulphate mixed in equal quantities

This mixture is suitable to reveal the hidden formative force of formic acid. We add a few drops of natural formic acid, or synthetic formic acid, and study the respective changes. Figs. 125, 126, 127, 128 represent such an experiment carried out in 1930. The percentage of acid in both cases was exactly the same.

The addition of the "natural" formic acid, changes in a most powerful way, the forming process ordinarily present in a mixture of silver nitrate and iron sulphate. The arrow like forms get much more pointed. To a certain extent they look rounded off, if these two metal salts act together, and they definitely change to a sharp pointed structure whenever we add natural formic acid. Another characteristic change we notice in studying the original experiment, is the colouration. Silver nitrate and iron sulphate give a greyish-black picture; the added natural formic acid permeates the picture with a warm yellowish-brown glow.

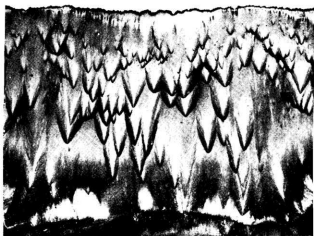


Fig. 125 1% silver nitrate and 1% iron sulphate plus natural formic acid (alcoholic extract)

Now we turn to the experiment containing "synthetic" formic acid (Fig. 126) and must state, that the rich forming process of the two metal salts has been subdued by the synthetic formic acid. There are considerably less forms, the clearness is changed into a veiled picture of a more uniform greyish-black. The few arrow like formations which pierce through that veil, are likewise changed to a more pointed structure. We get, quite definitely the impression, in comparing the three experiments (Figs. 124, 125, 126) that the natural formic acid has enhanced a certain form process, and made it look more "lively"; the synthetic formic acid, has subdued it, and nearly destroyed the characteristic silver-iron formation.

The "pure" chemical substance has nothing of the life process in itself which the animal excretion possesses so abundantly.



*Fig. 126 1% silver nitrate and 1% iron sulphate
plus synthetic formic acid*

These experiments can teach us to think twice before we substitute the purest chemical matter for fresh substances from the animal—or plant kingdom. Also remedial effects in synthetic substances must be accordingly different.

Many more examples could be given. We can only add one more in this connection. Fig. 125 represents an experiment with natural formic acid containing alcohol. Is there any difference between an alcoholic extract of formic acid and an extract where simply distilled water has been used?

The comparison between Figs. 127 and 128 gives a similar result to the comparison between Figs. 125 and 126. The natural formic acid enhances the formation, the synthetic one subdues it. Now we must compare Fig. 127 with Fig. 128 to discriminate between the alcoholic extraction and the extraction with distilled water. We hope it is possible for the reader who has only the prints and not the beautiful originals before his eyes to notice the great difference which exists between these two extracts. The watery extract is certainly more active than the alcoholic one. The single forms are still more pointed and represent clear triangles. The colour of the original was even more lively yellow-brown than that of the alcoholic extraction.

There is no doubt that the watery extract is more powerful than the alcoholic one.

Fig. 127 1% silver nitrate and 1% iron sulphate plus natural formic acid extracted with distilled water

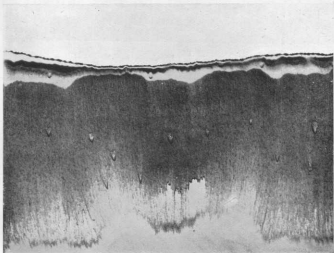
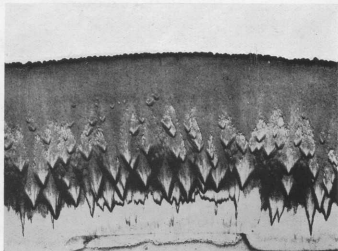
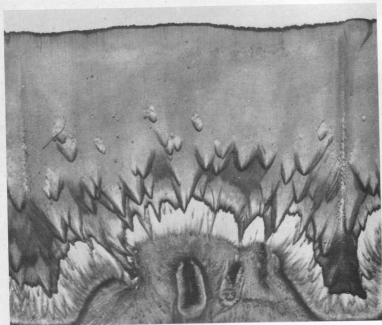


Fig. 128 1% silver nitrate and 1% iron sulphate plus synthetic formic acid

Each experiment is, to a certain extent, the endeavour to find an answer to a question we bear in mind. In a way, the answer given, puts at the same time a new question before our searching minds, which urges us on continuously, to strive for a real understanding of nature. So we arrive at the next question : How long may we keep these various extracts so that they still contain their strength, their value as a remedy, for instance ?



*Fig. 129 1% silver nitrate and 1% iron sulphate plus
natural formic acid extracted with alcohol*

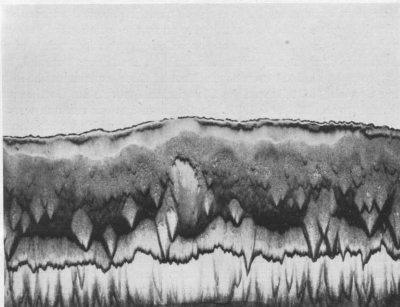


Fig. 130 1% silver nitrate and 1% iron sulphate plus the extraction used in Fig. 129, after it had been kept for 8 years in an airtight bottle.

The powerful watery extract loses its effectiveness after some time. The alcoholic extract still produces the aforementioned changes, after having been kept in an airtight bottle for eight years. (Figs. 129, 130.)

We came to the following conclusion: The alcohol weakens the extract in comparison with the watery extract—but it preserves this condition for a considerable time.

The best remedy will be made from fresh watery extract. The next best is a not too old alcoholic extract. Synthetic formic acid has not much value as a remedy.

The Formative Forces in human excretions, studied with the help of Capillary Dynamolysis. The possibility of using this test for diagnosing diseases

The study of the formative forces in the Mineral Kingdom, and later on in the Plant Kingdom, quite naturally gave rise to questions about the formative forces in the Animal Kingdom; and so we started to study the excretions of various animals, and, at the same time, studied human excretions from various points of view. We will at first report about our studies concerning human excretions, and, in the next chapter proceed to animal excretions. Most of these experiments have been published in German "Mitteilungen des Biologischen Instituts am Goetheanum" Nr. 1 and Nr. 4 between 1934 and 1935. In the meantime our research work has been continued, and enormous material has been piled up, which we are doubtful if we shall ever have an opportunity of publishing. Since we are dealing with a completely new method of scientific research it is necessary to explain many details with photographs and the reproduction in print is very expensive, so that an exhaustive treatment of the subject is scarcely possible.

For our researches it is best to study urine excreted in the morning, because during day time the concentration of the excretions varies considerably, according to the amount of liquids consumed. The experiments are conducted in the usual way: filter paper is dipped in freshly excreted urine. The liquid rises and reaches after some time the rising limit, which varies according to the concentration of the urine. For years we studied these variations of male and female excretions daily and got interesting graphs. But this part of our research work will be dealt with in another publication. After the filter paper has become dry again, we notice a slight yellow coloration and a more or less broad border zone (Fig. 131).

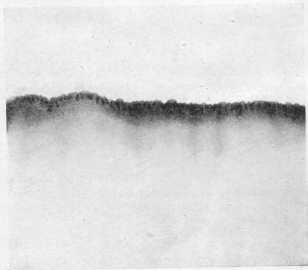


Fig. 131 Urine test of a healthy human being



1% NITRATE OF SILVER
FOLLOWED BY HUMAN[®] EXCRETION

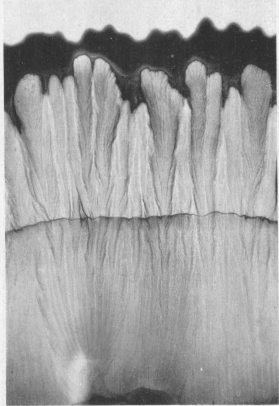
These border lines vary considerably if the excretion comes from an unhealthy person, and there exists a detailed account of such variations in the book *Studien über die Anwendung der Capillaranalyse, I. bei Harnuntersuchungen, II bei vitalen Tinktionsversuchen*, by Friedrich Goppelsroder. Verhandlungen der naturforschenden Gesellschaft in Basel, Band XVII. We have mentioned already in our previous chapter, this well-known scientific method, and we appreciate fully its value ; but the formative forces which are hidden in the various human and animal excretions cannot be found in this way.

Thus we use as a detector, as we have described for the study of the formative forces in the plant kingdom, metal salt solutions, for instance, nitrate of silver. Specific forms appear, which vary according to the individual from which the excretion is taken. Specially interesting forms are noticeable in excretions from unhealthy persons.

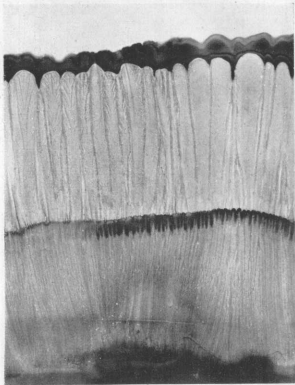
A much more interesting experiment, however, is **if we reverse the sequence of substances**, and let the metal salt—nitrate of silver, rise first into the filter paper. When this picture has become dry, we add the urine. The urine passes through the silver nitrate, and, during this process, engraves a beautiful structured picture. We add a coloured reproduction which can, at least to a certain extent show the original colours. The rising urine partly dissolves the silver nitrate deposited previously into the filter paper and carries this substance to the top, where we find it again as a brown border line, intersected with bluish-grey featherlike formations. Of course it would be necessary to reproduce many such pictures to give the reader a good basis for his own judgment. At present this cannot be done. Perhaps later on we can make a more detailed publication on this subject alone.

There is a great difference between the excretion of younger or older people. Younger persons, if they are healthy, produce a more brownish colour and softer forms ; older people, bluish-grey colours and stiffer formations. This phenomenon can be observed on Figs. 132 and 133.

A long and careful study is necessary to be able to judge with absolute certainty, whether the excretion comes from a perfectly healthy person, or whether pathological changes are present. Each individual has a characteristic formation. But it is possible to use our method of Capillary Dynamolysis to **diagnose in the excretions various diseases**. We carried out these observations for more than fifteen years, with a large number of healthy and sick people. Dr. Kolisko, as medical officer in the Waldorf School, Stuttgart, cared for about 1,200 children and made liberal use of this method for diagnosis ; as he did also later on, in his clinic in Burghalde. From this experience we can state, that it is not only possible to give the correct diagnosis for various diseases, but we can also follow up the healing process. Capillary Dynamolysis is a very subtle method, which is able to show the beginning of a disturbance in the equilibrium of forces very early, much earlier than is possible with a chemical or microscopical test. The equilibrium of the forces is disturbed before we can see it in actual disease ; that means it is possible to **prevent** the outbreak of a disease in



*Fig. 132 Silver nitrate 1% followed
by urine of a younger person*



*Fig. 133 Silver nitrate 1% followed
by urine of an elderly person*

time, and to continue the treatment long enough to ensure a real cure by watching the gradual recovery of the lost equilibrium. We report briefly a few cases :

(1). **Inflammation of the kidneys.**

The urine of a young girl had to be tested, because the physician suspected nephritis. The chemical test (which we always carry out as a control measure) gave the following result : colour of the urine—slightly yellow ; spec. weight—1.017 ; reaction—sour ; albumen—positive. Microscopic test : a great number of leucocytes, some red blood corpuscles, crystals of calcium oxalate. The test with Capillary Dynamolysis produced the picture represented in Fig. 134.

It shows that the formative forces are disturbed. A young healthy girl never has in the excretion such veiled, greyish, dirty-looking forms. It is possible to diagnose with certainty the beginning of nephritis.

Two days later we had another specimen to test, and found that the albumen had increased, and the microscopical test showed that not only many leucocytes and some red blood corpuscles were being excreted, but that there were as well hyaline cylinders and other tube casts. It was quite definitely nephritis and the Capillary Dynamolysis (Fig. 135) showed clearly the further progress which the disease made, in reducing the normal formative forces to a great extent. The whole picture seems covered with a dirty greyish veil. After recovery, the capillary dynamolitical test revealed the restored, normal formative forces in Fig. 136.

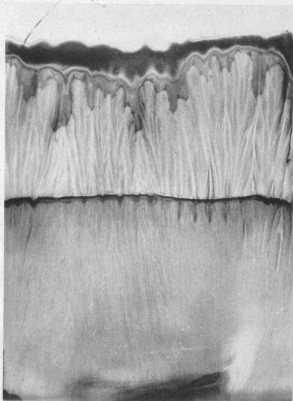
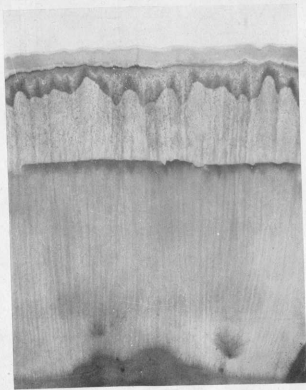
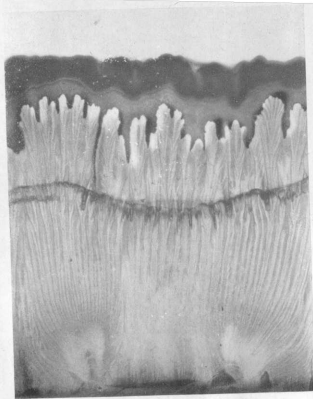


Fig. 134 Silver nitrate 1% followed by urine of young girl, with incipient nephritis



*Fig. 135 1% Silver nitrate, urine
excreted during nephritis*



*Fig. 136 1% Silver nitrate, urine
excreted after recovery from nephritis*

(2.) Example of a patient suffering from **kidney stones**.

This patient had been treated by his physician for a long time, and we were asked to test the progress of the treatment with our method. Persons suffering from kidney stones usually show very interesting phenomena in their excretions. The formative forces which are normally present, are to a certain extent intensified and deviate from their ordinary course. If we study, for instance, Fig. 137, we notice that the forms look **twisted** and the coloration is a more vivid brown. During the time of an acute nephritic colic, the excretion produced the picture represented in Fig. 138, where a strong radiating force penetrates the leaflike structures. The colour was between brown and orange. Such a test looks "beautiful" and inexperienced observers often come to wrong conclusions.

(3.) Example of a patient suffering from **Diabetes**.

A young girl of eighteen suffered for years from diabetes. The chemical test gave the following result: colour—light yellow; spec. weight—1.042; reaction—acid; albumen—O; sugar content—between 6 and 8%.

The test with Capillary Dynamolysis tells us that the formative forces are practically effaced. If we study Fig. 139 we come to the conclusion that the excretion is devoid of all the forces which should radiate through it. A few days before the patient died, the test proved even more the complete lack of formative forces. (Fig. 140.) The colour of the picture had a warm brown tone.

We mention here only a few cases and give the proofs for one metal salt—nitrate of silver. We could as well make the Capillary Dynamolysis test with other metal salts. It is not difficult to make these tests as far as the technique is concerned. A child can dip filter paper in solutions and get "a picture," but to **read the result** needs a great experience, especially if the responsibility is undertaken to judge health or illness. Nobody should accept this responsibility before having acquired a thorough knowledge of the various substances used for the test. Mistakes may prove disastrous in this sphere.

For instance, we might test the various excretions with a copper salt. Again we find that each person reacts in a specific way. It is even possible to come to certain conclusions about the **temperament** of the person whose excretions we examine. We regret that we cannot go into details here.

If we use for the test sulphate of copper in a 2% solution, it is best to start the test with the urine and later on to follow with the metal salt. As an example we show in Fig. 141 such a test with the excretion of a healthy young man, in Fig. 142 the same test carried out with the excretion of the patient suffering from nephritis and in Fig. 143 the test with the excretion of the patient suffering from kidney stones.

The test with silver nitrate used in the case of nephritis showed, that the formative forces were suppressed, the picture veiled. The same phenomenon we read from the test with copper sulphate.

The test with silver nitrate used in the case of kidney stones revealed exaggerated formative forces. The same phenomenon we find in the test with copper sulphate.

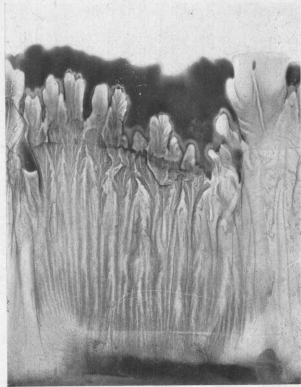


Fig. 137 1% silver nitrate, urine of a person suffering from kidney stones

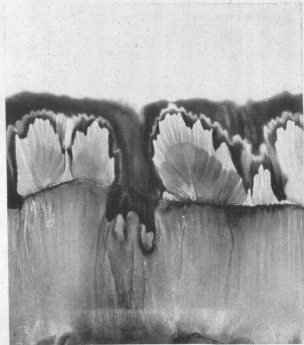


Fig. 138 1% silver nitrate, urine excreted during an attack of nephritic colic

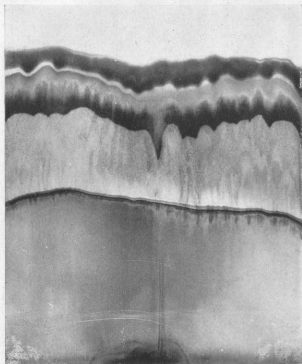


Fig. 139 1% silver nitrate, urine from a patient suffering from Diabetes

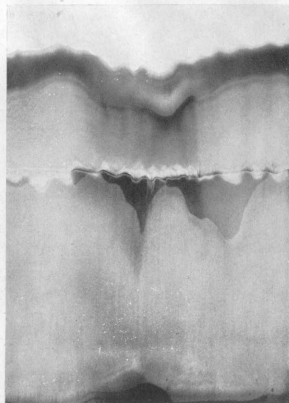


Fig. 140 1% silver nitrate, urine from a patient suffering from Diabetes



Fig. 141 Urine of a healthy young man followed by 2% copper sulphate

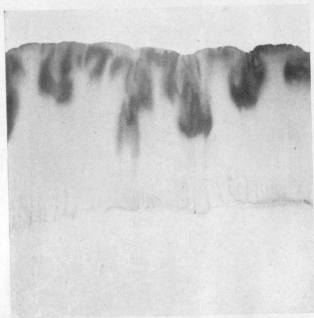


Fig. 142 Urine of the patient suffering from nephritis, followed by 2% copper sulphate

We observe a too strong plastic force active. The single forms look like balloons fully blown up, ready to burst.

If we summarize briefly these few examples, we may say : In a healthy human organism we find a normal formative force acting within certain limits. These limits can be overstepped in the one or the other direction. Either the formative forces may be dimmed down (kidney inflammation) or even completely suppressed (diabetes) or they can be too strong, radiating through the kidney system in an exaggerated way, instead of being used in the organism ; then kidney stones are deposited.

We want to point out, that these are only a few examples. We have collected an immense amount of material, which has convinced us that this method of Capillary Dynamolysis can be most helpful in medicine. The excretions do not only reveal diseases connected directly with the kidney system. An intimate study can penetrate also into the sphere of diseases belonging to the respiratory and circulatory system, as well as to the metabolic system. We regret that we cannot deal with all these problems in this chapter.

Another advantage of this method is, that we can diagnose the approaching illness much earlier, than with any chemical test. One example is, for instance, if the chemical analysis is completely negative, although the physician suspects a certain defect. The Capillary Dynamolytical test reveals without fail, if the suspicion is



*Fig. 143 Urine of the patient suffering from kidney stones,
followed by 2% copper sulphate*

justified or not. Fig. 144 represents such an instance, where the chemical analysis states : the excretion is perfectly normal ; our test says : disorder in the respiratory system ; there is possibility of asthmatic conditions.

A completely new and beautiful world opens for future research work. But we cannot emphasize enough : it demands a strict training and discipline. Since I have lectured for years about these subjects, I have watched how the public reacts when seeing such striking results. It happens often that the eye gets caught by some unimportant detail which appeals to the aesthetic sense. It has to be understood, that **beauty does not always mean health**. I sincerely hope that I can make it clear on these few pages which are at my disposal : **For the interpretation of these experiments we need sober judgment.**

In the case of kidney inflammation the picture is veiled by a dirty greyish appearance ; in the kidney stones, it is veiled by a brownish-orange glow and radiating formations. We must understand that the truth is only to be found **behind both veils, the veil of greyish dirt, and the veil of glowing beauty.** Between both is the normal, healthy condition. The state of equilibrium can deviate to the one or to the other side ; but each deviation means ill health.



Fig. 144 1% silver nitrate, Urine with negative chemical test but positive Capillary Dynamolytical test

Now we pass on to the next chapter dealing with animal excretions.

Capillary Dynamolysis as a means of studying the qualities of animal excretions
which thus enables us to judge their value as manure

We began these researches as early as 1925 and are indebted to the veterinary surgeon **Dr. C. Werr** for the general interest he took in the work, in sending us all the required samples of animal excretions. We were able to study hundreds of cows of various big cattle breeders in Germany, and later on went through the livestock of many farmers. We started to lecture about this highly interesting and important subject in 1929, but we could publish only in an inadequate way, just touching the subject and printing one or another experiment—(*Mitteilungen des Biologischen Instituts am Goetheanum*, Nr. 1/1934, Nr. 2/1934, Nr. 3/1935). In our lectures and to visitors to our laboratory who wanted to see the originals of the experiments and hear how they were obtained, we gave many details which we have not published. Even in this book we are unable to do more than roughly outline our researches and give a glimpse into 18 years research work.

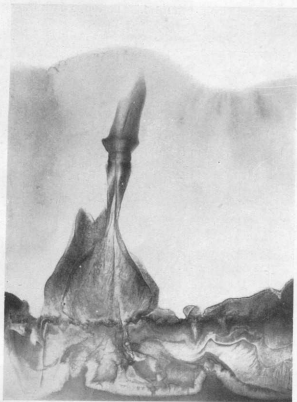


Fig. 145 Urine of a cow, followed by 1% silver nitrate

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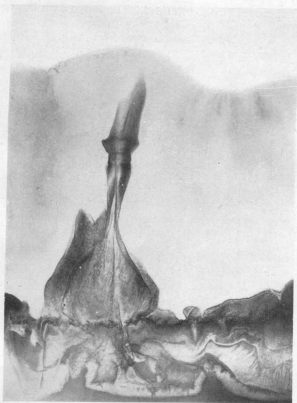


Fig. 145 Urine of a cow, followed by 1% silver nitrate

We start with cow's urine, making the same tests as described in the previous chapter with human excretions. According to the concentration of the excretion the rising limit varies, sometimes it is higher, sometimes not so high as water. When the cow is healthy, we get only a slightly yellowish coloured border line, more or less intersected with tiny waves. When we add nitrate of silver (Fig. 145) the specific formative force begins to work. The result is a rather coarse, simple, flame-like formation in the middle part.

If we compare this type of experiment with similar ones carried out with human excretions we come to the conclusion, that the formative forces acting in them are working in a much more subtle, we might even say, in a much more complicated way. The colours are also different. The animal excretion reduces the silver nitrate into a dark brown, sometimes reddish brown, whereas the human excretion changes it only to a light brown.

We reverse the sequence of the substances (see previous chapter) and find the same phenomenon; using as the first substance nitrate of silver, and afterwards the cow's urine, more characteristic results are obtained. The urine must rise into the preformed silver picture, and passes the border line formed by silver nitrate (coloured plate). Such an experiment looks beautiful. The top is dark brown, nearly black,

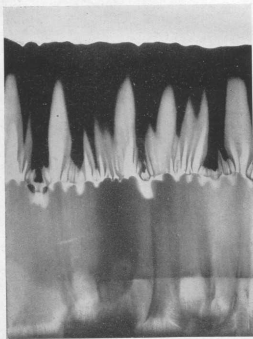


Fig. 146 1% silver nitrate followed by cow's urine



1% NITRATE OF SILVER
FOLLOWED BY COW'S EXCRETION

with a metallic shine in it. This means that the silver nitrate has been reduced with a great strength. From the middle part flamelike forms rise. The inner part of these flames is clear yellow with orange shades. The border line which separates the flames from the dark silver nitrate surrounding, is of glowing orange. The lower part of the picture, which is devoid of forms, is of a light orange-yellow. The immediate impression we get in looking on the original is : **how full of life the picture is.** Life forces stream through this picture. We turn back to the human excretion (coloured plate 1) and find it now, in comparison with the cow's urine, **dead.** The blue-grey coloration, the carved in, sharp forms are in themselves beautiful, but mineralized and dead, if we compare them with the cow's urine. We add a few more examples of cow's urine, so that the reader may have a better possibility of judgment (Figs. 146 and 147).

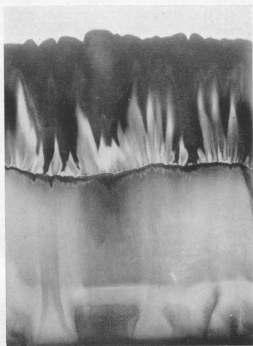


Fig. 147 1% silver nitrate followed by cow's urine

These experiments are of great importance for the farmer and gardener. They show plainly the difference between a living and a dead substance. We only look on these two types of pictures, then ask : **which substance is able to bring life forces into the soil?** There is not the slightest doubt that the cow's urine answers this purpose, but not the human excretion.

There is undoubtedly life force in the excretion, but considerably less than in that of the cow. The formations are more complicated but less vital. The colours lack the glowing orange shades, they are only vivid brown. Characteristic for horse urine are the tiny black spots which fill the single forms. We again regret that we cannot enter into details here.

The excretion of **pigs** is also extremely interesting. Usually we call the manure from pigs "cold" in comparison with the horse manure. The latter is a "hot" manure which we need in our warm beds or for mushroom culture. Of course the horse manure produces not only heat, but we appreciate this quality especially. The pig manure has very little life. If we study the pigs, we know that they again use thoroughly the food they get; they transform it into fat, put on weight and therefore their excretions cannot retain many valuable substances. Pigs are greedy, and make the best possible use of their food. Pig manure alone could not help the soil very much. The Capillary Dynamolysis test gives a good illustration of the qualities hidden in pig's urine (Fig. 149).

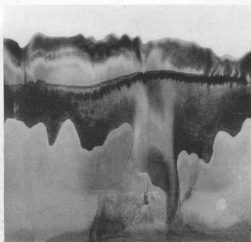


Fig. 149 1% silver nitrate followed by the urine of a pig

We studied the excretion of pigs with great care for a long time, to see if perhaps another combination of metal salts would show better results, and reveal stronger life forces. Whatever we chose, we got the same negative effect. For instance, we may compare the result obtained with gold chloride and the excretions of a pig, a horse, or a cow (Figs. 150, 151 and 152).

Judging the results from the point of view of value as manuring substance, we must state, that the pig's excretion has the lowest value, the second best (in this series) is the horse, and undoubtedly the best, is the cow's excretion. The pig's excretion completely destroys the inherent beauty of gold chloride; the pure colours

of yellow and mauve give way to a dirty greyish-mauve which spreads over the whole picture and no form whatsoever appears. The horse urine also makes the pure colours of gold chloride look less pure, greyish-mauve, but characteristic forms are engraved. The cow's urine is chaotic in its formation, but brings out a great beauty as far as colour is concerned. The original impresses us again with the quality of **life**; it is a chaotic, but very active life force visible. The horse urine is less permeated with life, but contains more formative strength. Thus we might grade the various excretions according to their content of life.

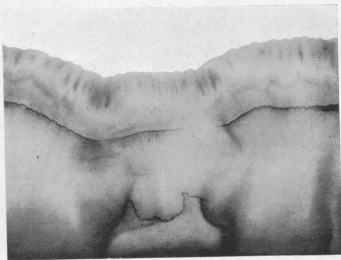


Fig. 150 Urine of a pig followed by 1% gold chloride

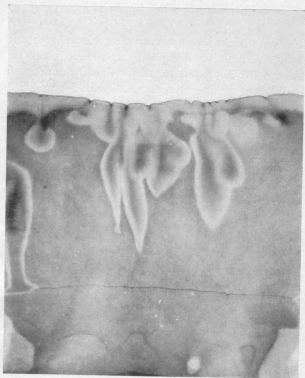


Fig. 151 Urine of a horse followed by 1% gold chloride

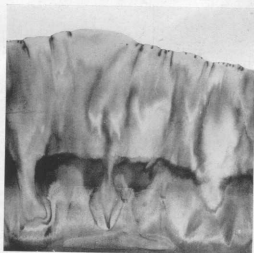
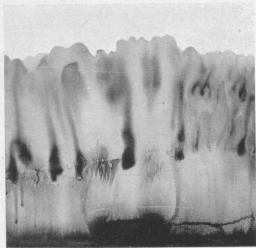


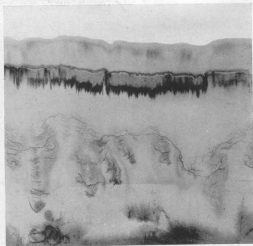
Fig. 152 Urine of a cow followed by 1% gold chloride

A wild boar differs from an ordinary domestic pig. (Compare Fig. 153 with Fig. 150).

The test with silver nitrate shows a very clear picture, quite unlike the result obtained in Fig. 149. We must say the photograph looks much too beautiful; the original simply conveys the impression of dirtiness and dullness, whenever we use pig's urine. The wild boar's urine always reacts with silver nitrate in a peculiar way. We ask the reader to pay attention to those strange lines engraved in Fig. 154. They look exactly like cracks in a wall. Their colour is dark brown with a slight red shade on a light-brown background. The test represented in Fig. 153 with gold chloride looks quite lively and does not disturb the display of beautiful colours, belonging naturally to tests with gold chloride.



*Fig. 153 Urine of a wild boar followed
by 1% gold chloride*



*Fig. 154 1% silver nitrate followed
by urine of a wild boar*

In the same manner we can study (and have actually done so) the excretion of all domestic animals, sheep and goats, cats and dogs, etc., and can, after some time, discriminate quite objectively between their value as a manure. We can state if they have retained more or less life forces.

We would like to give one more example for the purpose of demonstrating the manifold possibilities given in our method of capillary dynamolysis. For instance we study the excretion of a **sheep**. Its urine has a specific gravity of about 1.030 compared with 1.032 of a cow, 1.040 of a horse, 1.012 of a pig. A sheep discharges about 1 to 5 litres urine daily (a cow between 10 to 25 litres). Hippuric acid is abundant, especially by a diet of new meadow hay. Also the urine of cows is rich in hippuric acid although less than the urine of horses. The capillary dynamolitical test with silver nitrate gives a vividly coloured and richly formed picture.



Fig. 155 1% silver nitrate followed by sheep's excretion

The original colours are dark brown and yellow, but do not produce the warm glow usually present in a test of cow's urine. Characteristic tests for sheep excretions can be obtained with another modification of our research method. Until now we have only published experiments where the liquids were **rising** into the filter-paper vertically. There is also the possibility to let the substances spread out horizontally. The filter-paper is fixed on a large wooden frame and from the centre the liquid is allowed to contact the paper. At first a circle is formed by the sheep urine and then silver nitrate is added and passes through, colouring and forming together with the excretion.

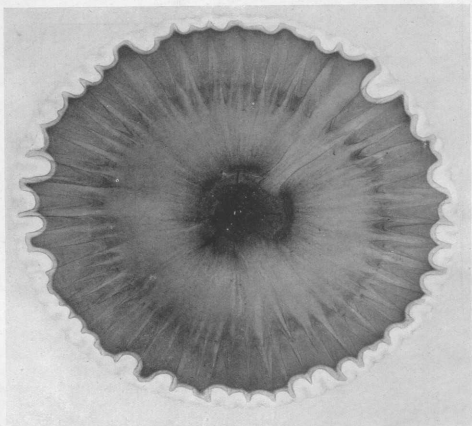


Fig. 156 Sheep's excretion, followed by 1% silver nitrate

The main characteristic is given by the strong radiation permeating the whole picture. Every healthy sheep will show the same phenomenon. We add one more example of this type of experiment in fig. 157.

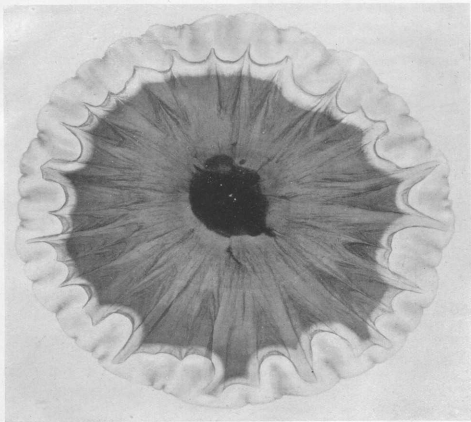


Fig. 157 Sheep's urine, followed by 1% of silver nitrate

This method can of course be applied as well to experiments with plant juices, or metal salts alone for special purposes. We cannot enlarge here on this particular branch of capillary dynamolysis. There are many advantages in it, but also some disadvantages. We add two examples with plant juices.

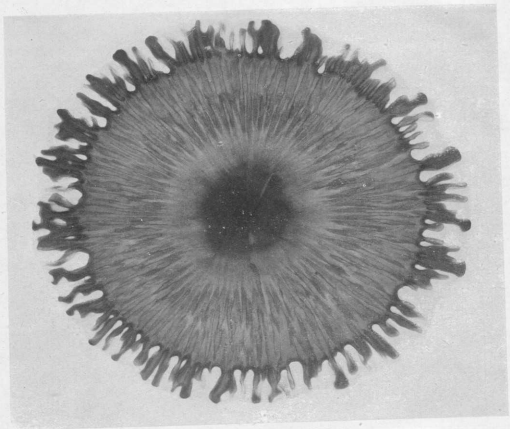


Fig. 158 *Extract of Dandelion (flower) followed by 1% silver nitrate*

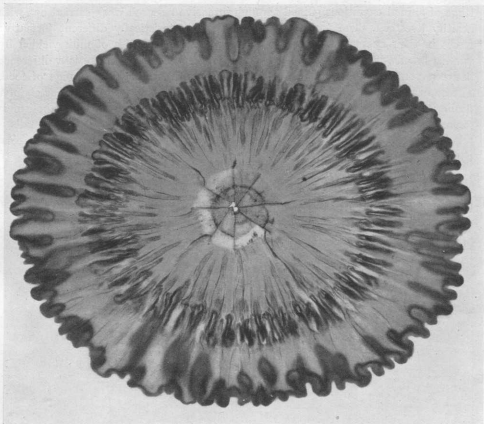


Fig. 159 *Extract of a carrot, followed by 1% silver nitrate*

Apart from these researches which we carried out, having in mind a purely agricultural viewpoint, we also studied the excretions of other species in the animal kingdom : camels, bears, elephants, lions. For this purpose we had to make friends with the personnel of zoological gardens, or sometimes we asked permission to collect the excretion of wild beasts in circuses.

Capillary Dynamolysis used for Diagnosing Animal Diseases

In Chapter X we explained the possibility of using our method for diagnosing diseases in human excretions, and the same method can be used for animal diseases. But again we have to point out, that first it is necessary to have a thorough knowledge of animal excretions gained through intensive research work carried out with healthy livestock. The various **breeds** have characteristically different formative forces in their excretions. Just as we have various qualities of milk yielded by various breeds, we have also various qualities of excretions. There is a difference between young or old animals. The excretion responds to each change of food. The cows have an enormously developed **metabolic system** (we refer to our chapter dealing with Foot and Mouth Disease) and every change in their metabolism is expressed in the excretions. Thus a real, intimate knowledge of all those details is required here. Even the cows vary in their temperaments, and we find typical changes due to this fact.

We are again faced with an absolutely hopeless task : to demonstrate a vast sphere of scientific research work with a few examples and a few sentences owing to paper restrictions and the great cost of a publication containing many illustrations.



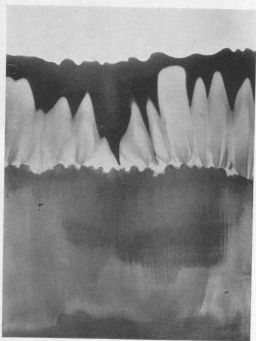
Fig. 160 1% silver nitrate followed by cow's urine

Fig. 147 represents the result obtained with a certain **breed**. The variations in the same breed are not so enormous, as those we find studying quite a different breed of cows. We hope to give a slight idea of those differences in reproducing the Capillary Dynamolytic test of a perfectly healthy cow belonging to another breed in Fig. 160

Again another type, but more similar to the one described in the previous chapter, is represented in Fig. 161 the cow and Fig. 162 the calf belonging to this cow.



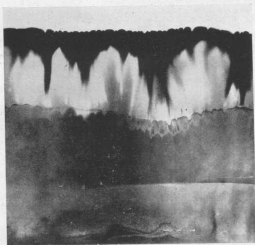
*Fig. 161 1% silver nitrate followed
by cow's urine*



*Fig. 162 1% silver nitrate followed
by the calf's urine*

Both tests are beautifully formed and coloured ; both are permeated with a strong life force. The trained eye can easily find that they "belong" to the same breed, only the one test shows a less developed formative force. The calf has not yet the burning torches of the fully developed animal. The structure is softer, wavering between round and pointed forms, the coloration is also softer in its tone.

Again we ask an interesting question : how long may we keep such an excretion, so that it still retains life forces, valuable as manuring qualities? For this purpose we kept about eighty specimens of various breeds in airtight bottles for **ten years** and then repeated the experiment. The result was extremely interesting. As far as the **colour** of the tests was concerned, the quality of the various excretions remained constant for ten years ; as far as the formative forces were concerned, they were less impressive, but still much could be seen. We give one example for this astonishing phenomenon in Fig. 163 the same urine as used in Fig. 162 from the calf—but ten years later. The experiment represented in Fig. 162 has been carried out in 1926 and the corresponding test with the same excretion kept in an airtight bottle has been carried out in 1936.



*Fig. 163 1% silver nitrate followed by
calf's urine (kept for ten years)*

Since all the examples of cow's urine given until now, represent German breeds, we find it necessary to add a few English varieties.

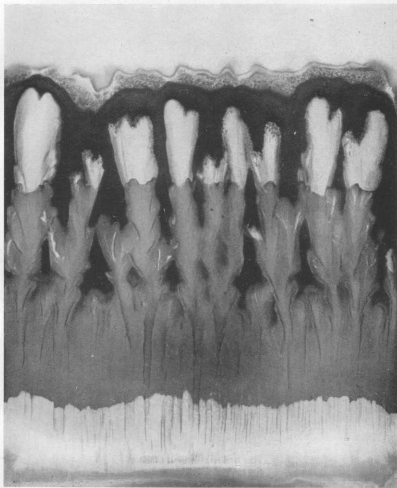


Fig. 164 1% silver nitrate followed by urine of shorthorn cow



Fig. 165 1% silver nitrate followed by urine of shorthorn calf

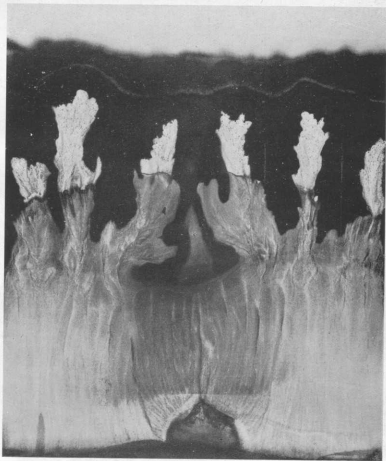


Fig. 166 1% silver nitrate followed by urine of Jersey cow

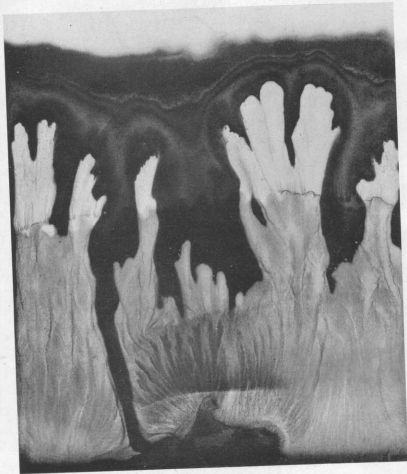
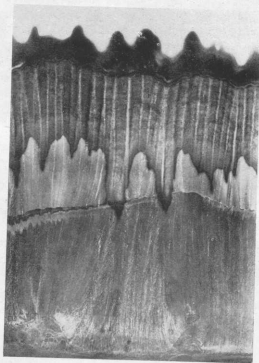


Fig. 167 1% silver nitrate followed by urine of black Welsh cow

Tuberculosis in Cows :

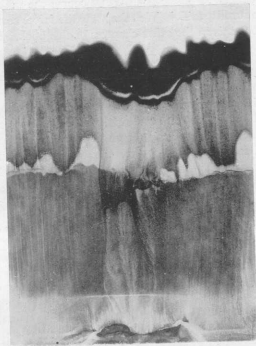
We take one example from the chapter on disease. Everybody knows how widespread tuberculosis is in cattle. We need not go into details about this. It suffices to state : it is a fact that the percentage of tuberculosis in cows is increasing and that means a great danger to public health. Of course the milk is sterilized—but what does it mean, to sterilize milk? We take away life forces contained in the milk. More will be said about this in the other chapters of this book. Here we only state the plain facts.

The excretion of cows diseased with tuberculosis produces characteristic changes in our Capillary Dynamolytical test. For instance, we examine all the cows of a certain breed belonging to one farmer. They produce, if healthy, pictures of the type shown in Fig. 147 and if we get a test similar to Fig. 168 we can be certain that this cow has tuberculosis in a "slight degree"—still it is sufficient to make the excretion less valuable for manuring purposes. The original lacks the glowing colours, it is dirty brown, the characteristic flaming torches are extinguished, streaky lines run from top to bottom.



*Fig. 168 1% silver nitrate followed by
excretion of tuberculous cow*

Fig. 169 is another example of an excretion from a cow suffering from tuberculosis. It shows the same lack in vivid colours ; it is less veiled and dirty than the



*Fig. 169 1% silver nitrate excretion
of tuberculous cow*

test Fig. 168, but shows the same characteristic streaks running from top to bottom. Still we consider this a more advanced case—the formative force has been more suppressed compared with test 168.

In Fig. 170 we demonstrate a very advanced case of Tuberculosis having lost all the brightness of colours and all specific formation belonging to a healthy cow's excretion.

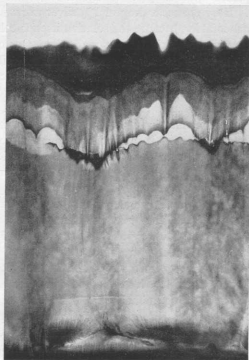


Fig. 170 1% silver nitrate followed by urine of a cow in an advanced state of tuberculosis

There are quite definite changes in the excretions which point to various diseases. We cannot go further into detail here, and must leave this to special publications later on. The great advantage of our method lies in the fact that we can diagnose tuberculosis in a very early stage, earlier than the veterinary surgeon can find it, earlier than the usual scientific tests can trace it, because the changes are earlier visible in the **life forces** of the animal, and later penetrate the various organs. Thus our method would enable treatment to be started at a very early stage, with a greater hope of curing the diseased animal. But certainly it is much better to raise our whole agricultural life to such a standard, that we avoid diseases. To achieve such a renewal in agriculture, or perhaps, more accurately : to show how such a renewal may come about, we have written this book, *Agriculture of To-morrow*.

What does it mean, that the excretion of a human being reduces the silver nitrate so that a greyish-blue or a light-brown colour prevails in the filter paper test, and that on the other hand, the excretion of animals, especially of cows, reduces the silver salt to such a degree, that glowing orange shades arise, and brown, darkening nearly to black, with metallic shine? We have given much consideration to this

fact, and want to explain it quite simply. Whenever we expose a silver salt to light, it reacts to the light. If by chance a drop of 1% silver nitrate falls on our clothes, we do not notice it immediately, because the solution itself is colourless ; but after a while, a yellow spot is visible, which darkens gradually. Our experiments use this capacity of silver nitrate to react to light and thus make visible what else would remain invisible. We have studied this substance ceaselessly for more than twenty years now and published a book about the connection between Silver and the Moon in 1929. We studied silver and its effect on Gold, Iron and Copper salts, etc., and have also, in this connection made various publications. This means an extensive study of **inorganic** matter is in the background of our study dealing with **organic** matter. We observe that, when we combine inorganic substance with an organic substance—plant juices or animal excretions—the strength with which the silver salt is reduced, varies considerably. Again, as a certainty, we may say : the stronger the influence of light which acts on a silver salt, the stronger is the reaction. If we expose nitrate of silver experiments to bright sunlight in summer, the picture is certainly darker brown, than if we expose it to the less bright sunlight in spring. Increasing light means increasing darkening of the silver solution on filter paper or any other material. The difference between an experiment with silver nitrate and organic substances is clearly demonstrated by a more vivid coloration and this phenomenon can be watched still more in using animal excretions. It is an **effect of light**. But where does the light come from ? We make various tests at the same time : silver nitrate alone, silver nitrate followed by human excretion, silver nitrate followed by animal excretions. They definitely show that the silver nitrate has been reduced in various degrees. The light which comes from outside is the same for all the experiments, still we observe a greater or less great effect of light. Since it cannot come from without it must come from within. The **organic substances contain various degrees of light activity in themselves and display this phenomenon in the Capillary Dynamolytical test**. Inner light and outer light meet.

This very simple test is nothing else but an interplay of the forces of light and substance.

Studying the various diseases we study the changes taking place in the **light-metabolism**. We have not only the crude metabolism of food, we have also the much finer metabolism of light. If we look at these tests from such a viewpoint, much light is thrown on certain diseases. If we have to deal with tuberculosis, the silver cannot be reduced in the ordinary way. There is not enough light activity in the diseased cow. (We find similar phenomena in cases of human tuberculosis.) There are diseases, where we must say, the light-metabolism is disturbed the other way round. Too much light is given off into the kidney system, is excreted, instead of being used inside the organism (e.g. kidney stones). If we understand in such a way the various entities in nature, we shall also find the right remedies to bring back the disturbed equilibrium.

COW MANURE SPECIALLY PREPARED IN A COW-HORN.

How to use this concentrated cow manure

Experiments—

- (1.) 1930 with sunflower seeds treated with this prepared manure, potentized to the 60th potency.
- (2.) The same experiment repeated in 1931.
- (3.) The same experiment carried out with gladioli, 1931.
- (4.) Comparative experiments with prepared and fresh cow manure, and a well-known chemical fertilizer (superphosphate), carried out with gladioli, 1932.
- (5.) Comparative experiments with :
 - E.1.—Cow manure buried in cow-horn during winter.
 - E.2.—Cow manure buried in earthenware pot during winter.
 - E.3.—Cow manure kept in earthenware pot during winter in the laboratory.
 - E.4.—Fresh cow manure.
- (6.) Test with our method of Capillary Dynamolysis (see Chapter XVIII, Part II) to study the difference between prepared and unprepared cow manure.

Cow Manure specially prepared in a Cow-horn during Winter

Perhaps we could say that the problem of agriculture is the problem of **manure**. How can we keep the soil alive? With each harvest we take life from the soil, and must put it back somehow. The most natural way would be to have a sufficient number of cattle and to use the excretion of the different animals (cows, horses, pigs, chickens, etc.). A really healthy agriculture must be regarded as a unity consisting of a certain amount of land, the appropriate percentage of animals, and the human beings living there. That is the ideal.

But nearly always we find that farmers have not enough cattle, and therefore not enough manure. They must buy it from somewhere else. That means that the farm is no longer in a really healthy condition. Sometimes we buy cow manure from the neighbour who is willing to sell the real thing—so that he may be able to buy chemical fertilizer to get a bigger crop.

The most precious possession of a farmer is the manure. It is the capital he has, to restore life to the soil. We have of course to discriminate between the manure we get from cows, pigs or horses. They vary in their manuring value. The most vital is cow manure. In the chapter "Foot and Mouth Disease," we have tried to give a picture of this animal and need not repeat it here. The cow is the represen-

tative animal of the metabolic process. The head is small in comparison with the rest of the body. The chief occupation of a cow is to eat, to ruminate, and to digest; and the excretion is the best we can get for the land. It contains enormous vitality.

Rudolf Steiner suggested making a specific preparation from cow manure, in order still more to concentrate these forces which we need to enliven the soil. In the chapter on "Foot and Mouth Disease," we mentioned the significance of the formation of horns. If an animal produces horns, and hoofs, it means that forces which could otherwise stream out through the skin are pushed back in those places where the organism develops a horny layer instead of the ordinary skin. The forces stream back into the body. The skin can breathe, there is a circulation between the inner organism and the outer world through the skin, but not through the horns. They resist and push back the forces which flow towards them from the inside.

We are advised to take the horn of a slaughtered cow and to fill it with fresh cow manure. Of course it should be the horn of a healthy animal which is not too old. Then we should bury this horn two to three feet beneath the surface of the soil during winter time. We must choose a good soil, rich in humus, which is neither too sandy nor has too much clay.

The cow manure is thus exposed to all those forces which stream through the soil in winter (we refer to Part I, Chapter III). Our experiments with plants growing beneath the surface of the soil show that during winter-time the temperature increases slowly beneath the surface, and wheat plants grow to a certain extent.

Crystallization reaches its maximum strength between January and February. There is much life beneath the surface of the soil, and we also find cosmic influences there; and here we place the cow-horn, filled with cow manure. In spring the preparation is complete. The manure has undergone an intensification and is now a **concentrated manure**, which can be used in **smallest quantities**.

How to use this concentrated cow manure

The manure that is now taken out of the horn has lost its smell. At first it is slowly stirred, adding a small amount of lukewarm rainwater, into a thick paste, then the amount of water is increased gradually until it forms a homogeneous thin paste. This is added to a bucketful of lukewarm rainwater, and we begin a vigorous stirring with a wooden stick. We have to mix the manure thoroughly with the water. It is some time before the water is fully permeated with the manure. It must be stirred for at least one hour without interruption, turning the stick round and round in one direction until the water forms a hollow whirlpool in the middle of the bucket; stir it in the opposite direction, and so on for one hour. The solution begins to smell like cow manure again, or rather like a good, fresh soil.

Having finished the stirring, the liquid can be sprinkled over the field. Not much is needed. For one acre of land, one bucket of liquid manure is sufficient. We dip a brush into the bucket, walk through the field, and shake out the brush vigorously to the right and to the left, in rhythmical movements. We soon learn how to do it, and feel how to use this strong vitalizing force.

If this method is introduced in larger areas, an apparatus which would allow a slight sprinkling is recommended, so that only one bucket full of liquid is distributed over one acre of land.

This preparation is applied to the soil before the sowing of the crop. It stimulates the life in the soil and helps the plants enormously in the first stages of germinating and pushing through the soil. It is advantageous if some time elapses between the spraying of this concentrated cow manure and the sowing of the seeds.

The question arises : How can we prove that manure which has been buried during the winter below the surface of the soil, is really different from an ordinary fresh cow manure ?

One answer to this question is, that for many years hundreds of farmers and gardeners all over the world have tried this method on their fields, and have realized its strong effect upon the growth of plants. Many controls have been carried out, and each one has proved that the areas treated with this cow manure show a much better and healthier growth, and the crop is considerably increased.

Another answer may be found by studying the effect of this concentrated cow manure with experiments in the laboratory and in the open. The most striking point in Rudolf Steiner's suggestion is that such a small quantity is used : the manure contained in one cow-horn dissolved in about three to four gallons of water should be sufficient to enliven one acre of land. Therefore, our first task is to find out whether cow manure, treated according to Dr. Steiner's suggestions, influences plant growth although used in so high a dilution, that for practical purposes we can hardly speak of a **material** influence, for the quantity is much too small. Some of our experiments will be described.

(1.) Experiment with Sunflower seeds in 1930

We used the manure of a cow-horn which had been buried from October 1929 until March 1930, three feet beneath the surface of the soil. The content of this horn (32 grams) was stirred into a thick paste with 50 c.c. of lukewarm rainwater ; then we slowly added more lukewarm rainwater, until we got an evenly distributed thin paste, which we poured out into an earthenware pot containing 10 litres of previously warmed rainwater. Then we began to stir in the prescribed manner for one hour. This is the preparation all farmers and gardeners should use to enliven their land. It has to be sprinkled over a wide area, so that in reality only here and there the liquid comes into contact with the soil. That means : **the force must radiate all over the land.**

For our experiment we consider this stirred cow-horn manure as the 1st potency. We take 10 c.c. of this preparation and add 90 c.c. lukewarm rainwater, put it into a perfectly clean glass bottle, and shake this mixture for about five minutes. Having such a small quantity to shake, we need only five minutes to get an even distribution of the concentrated material into the water. This represents our 2nd potency. From this bottle we again take 10 c.c. and add 90 c.c. of fresh lukewarm rainwater, take another clean glass bottle and shake again for five minutes. This is our 3rd potency ; and so we proceed until we have finished sixty **potencies** in sixty bottles.

Then we take sixty-one dishes and pour 20 c.c. of the different potencies into the dishes. One dish is filled with rainwater only. We insert sunflower seeds. The seeds have to be selected carefully to ensure that they are equal in growing energy. We cannot just take any seed that happens to be there. We must look carefully and see that each seed is perfect in shape and colour, and possesses all the qualities that guarantee a healthy plant later on. Selecting the seeds is an art which has to be learnt.

The seeds must remain in these glass dishes until they germinate, which is between twenty-four and forty-eight hours later. During the germination process we already observe considerable differences. Some potencies start the germination very quickly, some of them take a much longer time, and some may even not germinate until after forty-eight hours. It is very important to be sure about the selected seeds—that the retardation in the germination is not due to a less vital seed, but only to the influence of the potency.

The next step is, that the tiny seedlings are transplanted into pots containing ordinary garden soil mixed with leaf mould. We have prepared the soil and the leaf mould and are certain that they do not contain any fertilizers. The plants are allowed to grow in these pots until they are about four inches high, and during these few days they are watered with the respective potencies. After this period the plants are transplanted into the open. The treatment with potencies stops. We could not use the various solutions in the open, without getting an undesirable mixture in the soil.

The sunflowers are planted in one long row, starting with the water control plants, and then proceeding from the 1st to the 60th potency.

We plant five rows, that means we have for each potency five plants as a control. The plants are measured every fortnight, and if possible we take a photograph later on of the experiment in the open.

The following figures were taken on the 11th September, 1930, shortly before the end of the experiment :

Length of the Sunflowers treated with Potencies of cow-horn manure, 1930

<i>Potency</i>				<i>Diameter of the top flower</i>	
			<i>cm.</i>		<i>cm.</i>
1	...	...	252	...	23.8
2	...	...	249	...	22.0
3	...	...	252	...	23.5
4	...	...	248	...	22.8
5	...	...	254	...	25.5
6	...	...	275	...	28.8 (13 smaller)
7	...	...	249	...	25.0
8	...	...	235	...	22.0
9	...	...	248	...	23.2

<i>Potency</i>			<i>Diameter of the top flower</i>		
			<i>cm.</i>		<i>cm.</i>
10	...	...	208	...	20.0
11	...	...	240	...	25.5
12	...	...	200	...	22.0
13	...	...	209	...	22.0
14	...	...	130	...	17.0
15	...	...	116	...	15.0
16	...	...	130	...	15.5
17	...	...	126	...	16.2
18	...	...	134	...	16.0
19	...	...	125	...	14.0
20	...	...	200	...	18.0
21	...	...	190	...	18.5
22	...	...	200	...	19.2
23	...	...	211	...	21.5
24	...	...	237	...	22.0
25	...	...	270	...	26.5
26	...	...	213	...	25.0
27	...	...	250	...	27.2
28	...	...	248	...	25.3
29	...	...	267	...	24.0
30	...	...	225	...	23.6
31	...	...	232	...	24.0
32	...	...	237	...	23.8
33	...	...	233	...	23.0
34	...	...	241	...	22.7
35	...	...	240	...	23.7
36	...	...	238	...	23.4
37	...	...	280	...	27.0
38	...	...	223	...	25.0
39	...	...	213	...	23.5
40	...	...	285	...	27.8
41	...	...	245	...	26.0
42	...	...	232	...	24.0
43	...	...	255	...	25.2
44	...	...	260	...	25.5
45	...	...	276	...	23.0
46	...	...	204	...	24.8
47	...	...	291	...	27.0
48	...	...	217	...	26.0
49	...	...	305	...	28.5
50	...	...	237	...	22.5

Potency			cm.		Diameter of the top flower cm.
51	...	...	127	...	18.0
52	...	...	275	...	26.5
53	...	...	395	...	35.0
54	...	...	390	...	30.0
55	...	...	375	...	32.0
56	...	...	335	...	33.0
57	...	...	398	...	30.0
58	...	...	370	...	28.7
59	...	...	370	...	30.0
60	...	...	385	...	31.5

The easiest way to see the effect produced by the various potencies is to draw a graph. Therefore, we show the graph (of course very diminished in size) below :

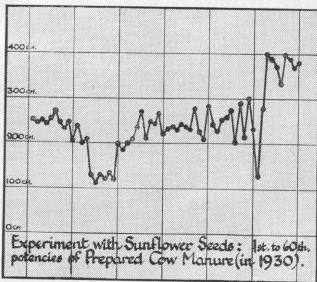


Fig. 171 Sunflower seeds treated with 1st—60th potencies of prepared cow-horn manure (1930)

If we try to describe the graph briefly, we might say that the whole graph is divided into two periods, the first reaching to about the 30th potency, and the second to the 60th potency.

The first period shows an increased growth as far as the 6th potency, then steadily falls to the minima between the 14th and 19th potencies. These potencies do not have a good effect upon the growing process of the sunflowers. Then we reach the first maximum growth at the 25th potency.

The second period indicated by the graph has a very marked minimum at the 51st potency, and the last eight potencies show a maximum growth reaching nearly four metres. That means, the higher we dilute, the stronger the action of the introduced **force**. We surely cannot speak of a **material effect** if we have diluted the manure to the 60th potency.

(2.) The same experiment carried out in 1931

We give the figures for the measurement taken at an early stage of development in the month of July :

<i>Potency</i>		<i>cm.</i>	<i>Potency</i>		<i>cm.</i>
1	...	202	31	...	192
2	...	195	32	...	188
3	...	195	33	...	183
4	...	205	34	...	206
5	...	188	35	...	196
6	...	203	36	...	194
7	...	174	37	...	203
8	...	190	38	...	178
9	...	194	39	...	174
10	...	189	40	...	196
11	...	184	41	...	196
12	...	154	42	...	175
13	...	152	43	...	193
14	...	102	44	...	192
15	...	90	45	...	204
16	...	93	46	...	164
17	...	98	47	...	120
18	...	92	48	...	173
19	...	96	49	...	223
20	...	142	50	...	223
21	...	145	51	...	170
22	...	163	52	...	192
23	...	165	53	...	237
24	...	200	54	...	229
25	...	225	55	...	225
26	...	194	56	...	226
27	...	202	57	...	235
28	...	201	58	...	241
29	...	228	59	...	267
30	...	178	60	...	269

The graph belonging to this experiment is reproduced on opposite page :

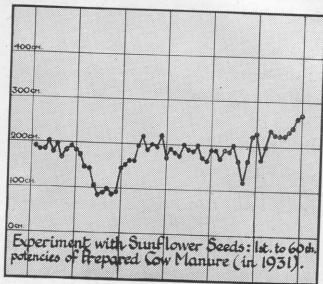


Fig. 172 Sunflower seeds treated with the 1st-60th potency of prepared cow-horn manure (1931)

The result, when compared with that of 1930 is nearly identical. We find the two periods expressed clearly in the graph, the minima between 14th and 19th potencies, the maximum at the 25th, and another one at the 29th potency.

In the second period of the graph we find the minimum at the 51st potency marked, but a stronger one appears at the 47th potency. The last 8 potencies show maximum growth.

(3.) The same experiment carried out with Gladioli. 1931

Here we must select the bulbs in the same careful way. We again use small glass dishes filled with the respective potencies and insert the gladioli bulbs. We use 5 bulbs for each potency (in 5 different glass dishes); that makes 300 glass dishes for the 5 series of experiments and the water control plants.

The bulbs are kept in the solutions until they begin to germinate, then they are immediately transplanted into the open and the treatment with cow manure potencies stops from this moment.

Of course the 5 bulbs we select cannot grow exactly the same length. There are slight differences between the bulbs. To find some hundreds of bulbs of equal vitality we must have thousands to select from. These we cannot buy, so we know that we can only approach the ideal, but do not reach it.

To find out how much these differences influence our result, we make the following experiment. In measuring the 5 plants we select at first all the biggest plants

for each potency, then we select the smallest ones and then we take the average of the 5 series.

We quote the figures for the gladioli measured on 9th July, 1931.

G.1=the largest plant of the 5 is selected.

G.2=the average growth of the 5 series.

G.1			G.2		
Potency		cm.	Potency		cm.
1	...	88.0	1	...	70.0
2	...	86.0	2	...	70.0
3	...	78.5	3	...	73.8
4	...	78.0	4	...	67.5
5	...	86.0	5	...	79.5
6	...	86.0	6	...	60.0
7	...	86.0	7	...	73.0
8	...	78.5	8	...	65.4
9	...	74.0	9	...	65.3
10	...	68.0	10	...	64.9
11	...	83.0	11	...	78.7
12	...	83.0	12	...	69.5
13	...	75.0	13	...	62.0
14	...	49.0	14	...	44.3
15	...	38.0	15	...	33.5
16	...	42.0	16	...	39.3
17	...	36.0	17	...	28.8
18	...	44.0	18	...	35.0
19	...	45.0	19	...	39.4
20	...	54.0	20	...	50.5
21	...	61.0	21	...	56.0
22	...	74.5	22	...	66.0
23	...	72.0	23	...	70.5
24	...	78.5	24	...	73.4
25	...	99.0	25	...	79.0
26	...	83.0	26	...	75.5
27	...	90.0	27	...	78.0
28	...	86.0	28	...	75.6
29	...	99.0	29	...	83.6
30	...	76.0	30	...	65.2
31	...	80.0	31	...	69.6
32	...	76.0	32	...	70.4
33	...	80.0	33	...	69.9
34	...	75.0	34	...	68.6
35	...	73.0	35	...	59.8

G.1			G.2		
Potency		cm.	Potency		cm.
36	...	70.0	36	...	64.0
37	...	69.5	37	...	62.3
38	...	65.0	38	...	53.0
39	...	65.0	39	...	58.0
40	...	75.0	40	...	63.5
41	...	75.0	41	...	61.7
42	...	69.0	42	...	53.7
43	...	74.0	43	...	60.7
44	...	76.0	44	...	68.0
45	...	77.0	45	...	65.0
46	...	66.0	46	...	58.0
47	...	68.0	47	...	56.0
48	...	65.0	48	...	57.0
49	...	89.0	49	...	73.0
50	...	95.0	50	...	68.0
51	...	73.0	51	...	68.0
52	...	84.0	52	...	88.6
53	...	102.0	53	...	88.9
54	...	105.0	54	...	94.0
55	...	103.0	55	...	84.7
56	...	92.0	56	...	82.5
57	...	108.0	57	...	88.2
58	...	108.0	58	...	93.6
59	...	125.0	59	...	101.0
60	...	127.0	60	...	109.0

Again we make a diminished sketch of the graph and can see at the first glance that there is a great similarity between this graph and that of the experiment with sunflower seeds. The minima are between the 15th and 19th potencies; the first maximum occurs at the 25th, the largest plants are obtained at the highest dilutions.

It is also obvious that we do not make serious errors in the selection of our bulbs, because the differences between the average length of the 5 series, and the series which contains the biggest plants of the 5 controls, are negligible.

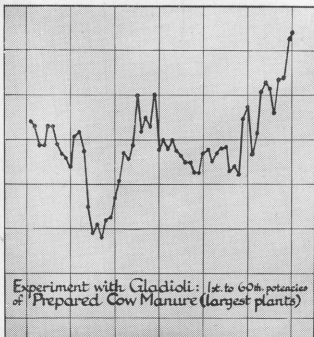


Fig. 173 Gladioli
treated with 1st-60th
potencies of prepared
cow manure in 1931

G.1 (the largest
Plant is selected)

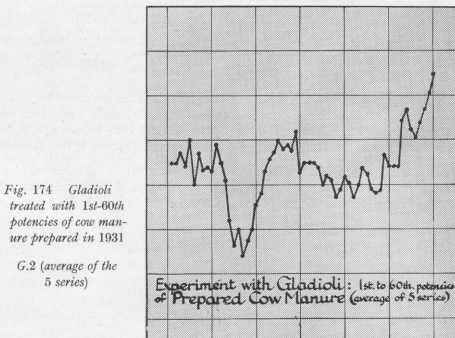


Fig. 174 Gladioli
treated with 1st-60th
potencies of cow man-
ure prepared in 1931

G.2 (average of the
5 series)

These questions still remain : (1) **Is it really important to prepare the manure in that strange way?** Would it not be the same if we potentize fresh manure? Or (2) If we bury the manure beneath the soil, *must it be in a cow-horn?* Can another horn be substituted for the cow-horn, or may we take any other material in which to keep the manure beneath the soil?

(4.) **Comparative experiments with prepared and fresh cow manure and superphosphate, 1932**

The first question may be answered with a comparative experiment. We again take bulbs of *Gladioli* and treat them with potencies of **prepared** manure: Experiment D.1 ; another series of potencies is made with **fresh** cow manure : Experiment D.2 ; and we make a third series with a chemical fertilizer : potencies of **Superphosphate** (Experiment D.3).

Potency	D.1 <i>Prepared cow manure</i>	D.2 <i>Fresh cow manure</i>	D.3 <i>Superphosphate</i>
1	92.0	58.0	90.0
2	54.0	49.0	69.0
3	78.0	79.0	63.0
4	74.0	77.0	74.0
5	72.0	76.0	74.0
6	77.0	80.0	103.0
7	77.0	70.0	63.0
8	86.0	96.0	69.0
9	90.0	92.0	94.0
10	87.0	92.0	69.0
11	82.0	87.0	90.0
12	91.0	95.0	105.0
13	85.0	88.0	105.0
14	88.0	92.0	86.0
15	99.0	82.0	79.0
16	84.0	70.0	114.0
17	64.0	56.0	67.0
18	67.0	76.0	74.0
19	87.0	67.0	93.0
20	82.0	79.0	74.0
21	96.0	95.0	47.0
22	108.0	102.0	48.0
23	90.0	86.0	93.0
24	94.0	93.0	113.0
25	116.0	106.0	110.0
26	88.0	92.0	44.0
27	88.0	96.0	88.0
28	100.0	88.0	72.0
29	70.0	92.0	94.0
30	102.0	102.0	68.0

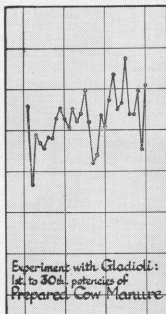


Fig. 175 D.1 (Prepared manure)

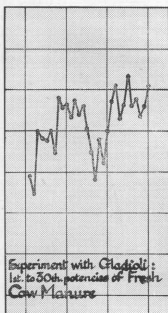


Fig. 176 D.2 (Fresh cow manure)

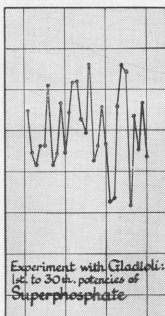


Fig. 177 D.3 (Superphosphate)

This experiment shows that the prepared cow manure in the 1st potency enhances the growth of the gladioli bulbs much more than the fresh manure. The plant is nearly twice the length (92.0 cm. : 58.0 cm.) ; then the prepared manure remains slightly behind the fresh manure. The minimum in both series happens to be the 17th potency, the maximum at the 25th. The minimum in D.1 is 64 : 56 in D.2, and the maximum in D.1 is 116 : 106 in D.2. So we can read from the graph, that the **prepared manure produces a higher maximum** and the **minimum is not so tiny**, as the corresponding plants treated with fresh manure.

The differences between the plants themselves were much more impressive. There was not only a difference in the length, but the whole character of the plants was different in both series. These plants which were treated with the prepared manure looked much stronger and healthier and the leaves were darker green. The vitality of the plant had been raised to a much higher level. Of course these characteristics cannot be seen in the figures and I regret that it is impossible to give the photographs.

It is difficult to compare these with the graph of the superphosphate series in which there are too many minima and too many maxima. We find the 17th potency as minimum, but the same minimum happens at the 3rd, 7th and 30th potencies. But still stronger minima are marked at the 21st, 22nd and 26th potencies.

The first maximum is the 6th, the second the 15th, and the third the 24th potencies. It is very difficult to read this graph. It is unstable ; there is a constant up and down movement. The plants themselves gave the same impression. It was puzzling to see rather small and shabby-looking gladioli, with yellow leaves, looking unhealthy, and then very tall ones with rather thin stalks. They had been forced too much. We can only say : that the gladioli do not like a treatment with superphosphate, but they feel very happy with the prepared cow manure.

(5.) Comparative experiments with "prepared" and "unprepared" cow manure, 1933

Someone may raise the objection when we compare "fresh" manure with the "prepared" : the difference in the experiment may be entirely due to the **age of the manure** and not to the special way of keeping it in a cow-horn buried during winter-time three feet below the surface of the soil. We therefore made the following experiment :

E.1 cow manure buried in cow-horn from October 1932 until March 1933.

E.2 cow manure filled in an earthenware pot and buried from October 1932 until March 1933 in the same place where the cow-horn was buried.

E.3 cow manure kept in an earthenware pot in the laboratory between October 1932 and March 1933.

E.4 fresh cow manure.

With these four substances we made again experiments with gladioli bulbs from the 1st to the 30th potencies, and quote below the result obtained :

<i>Potency</i>	<i>E.1</i>	<i>E.2</i>	<i>E.3</i>	<i>E.4</i>
	<i>Manure buried in cow-horn</i>	<i>Manure buried in earthen- ware pot</i>	<i>Manure kept in earthen- ware pot in laboratory</i>	<i>Fresh cow manure</i>
	<i>cm.</i>	<i>cm.</i>	<i>cm.</i>	<i>cm.</i>
1	90.0	55.0	45.0	27.0
2	82.0	57.0	50.0	100.0
3	95.0	75.5	68.0	96.0
4	100.0	78.3	61.0	98.6
5	100.5	78.0	76.2	65.5
6	98.0	65.7	62.5	90.0
7	100.0	58.2	50.0	85.3
8	102.5	73.0	67.5	63.0
9	100.0	60.0	60.3	77.5
10	107.5	63.0	51.0	86.0
11	100.0	72.0	65.0	87.5
12	90.0	41.5	37.0	36.0
13	105.0	75.0	55.3	70.0
14	75.8	70.3	55.0	91.0
15	90.0	72.0	63.3	82.5
16	45.0	68.0	72.5	75.0
17	75.0	55.0	60.0	70.5
18	100.0	80.3	60.5	83.5
19	85.0	63.0	62.5	100.0
20	89.0	70.0	65.0	70.0
21	95.0	80.0	89.0	85.0
22	100.0	60.0	70.0	55.0
23	82.5	7.5	19.5	10.0
24	100.0	30.0	41.0	41.0
25	75.0	65.0	50.5	70.0
26	120.0	88.0	65.0	85.0
27	93.0	65.5	51.5	60.0
28	115.0	70.0	50.0	75.0
29	88.5	70.3	69.0	65.0
30	70.0	61.0	55.0	70.0

We reproduce the graphs for these four experiments below :

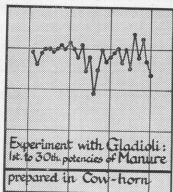


Fig. 178 E.1

Manure prepared in cow-horn

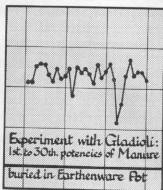


Fig. 179 E.2

Manure buried in earthenware pot

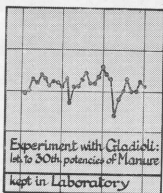


Fig. 180 E.3

Manure kept in laboratory

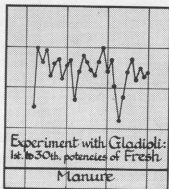


Fig. 181 E.4

Fresh cow manure

It is interesting to compare these figures. The 1st potency in E.1 shows better growth compared with E.2, E.3, E.4. Of course all the four different manures have undergone the same treatment: the same quantity of manure had been stirred into a thick paste with lukewarm rainwater, then into a thin paste, then stirred into a bucketful of lukewarm rainwater, and from this dilution we started to potentize. We find that the fresh manure does not influence the plants favourably and has to be further diluted. Only when the manure has been buried during winter in the soil, surrounded by the cow-horn may we use it in this concentration with benefit to the plant life. We must say, that the fresh manure is **not digested enough** to enter immediately into the plant organism. **It is still too much impregnated with animal forces.** In keeping the excretion of the cow enclosed in the cow's horn, we

lead the digestion one step farther. We get then, an immensely powerful, vitalizing manure. " Fresh manure " cannot be taken in by plants, it has to be transformed into humus, it must reach a certain stage of decay. In this lies the great art of making a really good manure or compost heap. We will deal with this problem in another chapter.

The figures for the 1st potency prove that the older manure, which has been kept in the laboratory from October to March is better than the fresh one, and the one buried in the soil in an earthenware pot is still better. But none of them is so valuable as the cow-horn preparation.

The 2nd potency means a drop for the cow-horn manure, and an enormous rise for the fresh manure, whereas only slight changes take place in the other two preparations.

Then we notice a slow climbing up in the cow-horn preparation until it reaches the 10th potency. From this point the graph indicates the opposite movement until the minimum is reached at the 16th potency. Again the graph rises and reaches the maximum with 120 cm. at the 26th potency.

The fresh manure experiment, E.4, has its maximum with the 2nd potency, then climbs down to the minimum at the 12th potency. The same point is marked in E.3 and E.1.

E.4 reaches the maximum with only 100 cm. again at the 18th potency, E.3 is similar (only at a lower level) and reaches the maximum at the 26th potency. E.2 marks the 21st potency, but reaches the maximum really at the 29th potency with 88 cm.

E.2, E.3 and E.4 have a second minimum at the 23rd potency.

Summarizing the result we may say : **the experiments indicate clearly a similarity between those experiments which have not been kept in the cow-horn ; and obviously the better results are produced by the preparation which has been made according to Dr. Steiner's suggestion.**

(6.) Tests with our method of **Capillary Dynamolysis**

We refer to Part II, Chapter VII explaining this method. It is a very good and quick test to find differences in the inner qualities of substances. We compare E.1 with E.4 : the fresh cow manure and the cow-horn preparations. Equal quantities of the liquid rise in the filter-paper and afterwards the metal salt solutions are added. It is not possible to include more pictures, so we choose from all our material two which we think, to a certain extent, convey the differences between these two preparations.

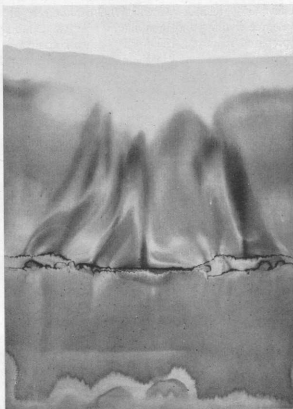


Fig. 182

Fresh cow manure and 1% of gold chloride

We must try to understand the language of these pictures produced by Nature. It is a science which has to be learnt through hard work, **but it is a Science, as accurate as we can wish for.** The fresh cow manure and the prepared one are not different to look at on the filter paper. After adding gold chloride the differences become visible. The fresh cow manure changes with the gold chloride to rather dull, dark-looking shades of brownish purple. We are very sorry that we are unable to have the original colours reproduced. The dark shades in the photograph represent the brownish purple coloration; the lighter one pale purple and some yellow. The picture is full of life, but a **chaotic life**, a rather coarse force.

Figure 165 the prepared manure scarcely needs an explanation. Even the black and white photograph reveals the brilliancy in the colours. The lower part of the picture, which is unshaped in the fresh cow manure, is in the prepared one worked through with delicate, many coloured forms, bright purple, bluish-purple, yellow, golden-yellow and greenish-yellow. Who cannot see, in the upper part, a strong formative force shaping and moulding? Life is expanding, streaming and radiating in the prepared manure ; the fresh manure contains all the forces, but still bound, chaotic, and concentrated in themselves ; they cannot radiate into the surroundings.



Fig. 183

*Cow manure buried in cow-horn between October 1931
and March 1932 and 1% of gold chloride*

The study of Capillary Dynamolysis tells us, that the prepared cow manure is a preparation filled with strong, radiating vital forces.

Part Three.

RUDOLF STEINER'S SUGGESTIONS
FOR A RENEWAL OF AGRICULTURE

Chapter II.

SUGGESTIONS FOR BUILDING UP A VALUABLE MANURE OR COMPOST HEAP.

The foremost task of manure is to bring life back into the soil. If this is so, it is hard to understand the propaganda for artificial fertilizers. We can never expect mineral salts to bring life back into the soil. We want the plants to take those different salts as food for themselves immediately. To-day we **feed the plants and neglect the soil**. The soil becomes more and more mineralized, and the plants are losing their appetite for the salts.

Those with a materialistic point of view, will support the opinion, that the effectiveness of cow manure (or any other organic manure) consists only in its content of mineral salts. So it is no wonder that many think it possible to substitute artificial fertilizers for organic manure.

Other scientists think that the micro-organisms in the soil, the bacteria, those millions and billions of micro-organisms, are responsible for the value of organic manure. With this point of view one can understand the methods of implanting bacteria into manure heaps, or of injecting bacteria into the soil. Of course a good organic manure contains a rich world of micro-organisms, but we mistake the effect for the cause. Because the manure is full of life—the bacteria thrive in it. But we can never make a manure heap better with the help of micro-organisms, if it is not good in itself.

We find that there are different methods of trying to enrich the life of organic manure. But we shall never be able to do this, if we do not really understand **life, nature as a whole, the interplay of earth and the whole cosmos**.

Rudolf Steiner suggests for the enlivening of a manure—or compost—heap, the addition of different plants, which must be prepared in a special way, and are then added in small amounts. These plants are :

Oak bark (*Quercus robur*).

Dandelion (*Taraxacum*).

Camomile (*Matricaria chamomilla*).

Yarrow (*Millefoil-Achillea millefolia*).

Stinging Nettle (*Urtica dioica*).

Valerian (*Valeriana officinalis*).

Chapter III.

The Oak Bark Preparation

- (1.) Introduction.
- (2.) Experiments with wheat growing under the influence of :
 - (a) Oak bark buried during winter in earthenware pot ;
 - (b) Oak bark buried during winter in the skull of a sheep.

(3.) Tests with Capillary Dynamolysis :

- (1.) Unprepared oak bark with iron sulphate.
- (2.) Unprepared oak bark with quicksilver chloride.
- (3.) Unprepared oak bark with gold chloride.
- (4.) Prepared oak bark with iron sulphate.
- (5.) Prepared oak bark with quicksilver chloride.
- (6.) Prepared oak bark with gold chloride.
- (7.) Oak bark prepared in skull of sheep, experiments carried out in 1929-30, 1930-1, 1932-3.
- (8.) Oak bark prepared in skull of ox, 1931-2 and 1932-3.
- (9.) Oak bark prepared in skull of a cow, 1935-6.
- (10.) Oak bark prepared in skull of a horse.

(1.) Introduction

Oak bark is a general remedy for plant diseases. That is how Rudolf Steiner puts it briefly. **Many of the so-called plant diseases can be cured through a reasonable manuring.**

We must add **calcium** to the manure. But here again Rudolf Steiner's principle for agriculture is : not to add the substances we need in a **mineralized** form. It is far better to find the calcium in a living process. If a plant contains calcium in its organism, then the calcium is included in the life process and is different from the solid mineral. It would not help the plant to dig calcium into the soil, because the plant could not take it in this condition immediately from the soil. But calcium which is already included in the living organism of a plant, can be transferred to another plant organism without difficulty. Therefore Rudolf Steiner suggests making a preparation from the oak bark which is exceedingly rich in calcium. The chemical analysis of the ash of the bark proves that the calcium amounts to 78% and in old trees even more calcium is found. The oak tree has large quantities of calcium in the bark, and it is also found in the wood to a lesser degree.

The bark is used as a remedy for different human diseases, especially for spitting blood, and bleeding at the mouth ; it prevents vomiting. It is a popular remedy for gastric ulcer and gastric bleeding, intestinal bleeding (blood-vomiting), diarrhoea, haemorrhoids, and so on.

The bark is a brownish silver-grey ; smooth ; shiny outside ; and inside is reddish-brown. The fresh bark smells of tannic acid, is slightly bitter to taste, and is astringent. There is a fairly large amount of tannic acid in the acorns, bark and wood (about 10 to 13% in the ash and we find an interesting process of phosphoric acid). It has been stated, that the content of phosphoric acid varies during the course of the year, as well as the content of calcium. In summer there is a larger amount of phosphoric acid (about 20%) and a smaller amount of calcium in the ash of the wood (19%). In autumn the phosphoric acid decreases to about 10 to 12% and the calcium rises to about 25%. The content of tannic acid does not vary so much during the whole life of an oak tree.

Dr. Steiner's suggestion is to take fresh oak bark of not too old a tree, and to break it up in small pieces. Then we must take the skull of any domestic animal and fill it with the oak bark. We close the opening of the skull if possible, with some bone of the animal; and bury this preparation during winter-time not too deeply in the soil. But we should choose a situation to which water has access. Much water should stream over the place. The skull could even be placed in a barrel with decaying plant substance at the bottom, and be buried in this plant substance. Rain-water has free access to the barrel and should also be allowed to flow away (for instance, a leaking barrel could be used). In spring we take the oak bark from the skull just in the right condition for the manure heap, with an highly *activated* calcium content.

(2.) Experiments with the Oak Bark Preparation

We tried the skulls of many domestic animals: cow, ox, calf, horse, pig, sheep. We also had the opportunity of comparing many preparations made by farmers and gardeners who were experimenting.

We found that it is **essential** to use the skull in a quite **fresh** and **undamaged condition**. The head should **never be split in halves**. **Never use a saw to open the skull and thus have easy access**. If we do this, then we spoil the whole process which we intend to produce. We must understand that during lifetime the skull protects a very sensitive organ: the brain. We have to replace the brain of the animal with the oak bark as quickly as possible without damaging the surrounding. If we really want to get the best result, we must take special care that the organs of the animal we use are intact, and that we retain as much of the life-forces as possible.

There is a way of substituting the oak bark for the brain without damaging the skull. Of course it takes more time, but it is worth while. We pull the brain out with a small wooden stick through the **natural opening** of the head (occipital foramen). The last particles may be washed away with a few drops of rainwater, but it is better to try to get the brain out without using water. Then the oak bark must at once be squeezed in, using a spoon if the oak bark is very pulverized; or we can use our fingers to help to press it tightly into the skull. It is quite possible to fill the whole space tightly with oak bark. Usually we can take off a piece of the jaw bone and fit it in the occipital foramen. This preparation has now to be buried.

We made many experiments, either having the skull buried in an open rain-water barrel, or in the soil, with running water over it, and prefer the latter method. We need not bury it very deeply; we cover the skull slightly with peat moss and then with soil. In spring, when we take the preparation out of the soil, we find the oak bark very much changed. The colour is nearly black, its **crumbly structure looks and smells like good fresh soil**. It is a beautiful preparation full of life. **Many micro-organisms** are in it. No one would believe that it is oak bark which fills the skull.

During the last twenty years we have seen many similar preparations and we know that many mistakes are being made. Very often the oak bark preparation has not undergone a real digestive process, then it looks still brown and lifeless and is much more like the ordinary oak bark we take from the tree.

Again the question arises : Must we really take the skull of an animal? Is it not sufficient to bury oak bark alone, or to have it in any other kind of vessel? Therefore we made a similar experiment to the one already described for the cow manure in the cow-horn. We made one preparation according to Dr. Steiner's suggestion, and another by placing the fresh oak bark of the same tree in an earthenware pot. We covered it tightly with a fitting lid and buried it at the same time in good soil. In spring when we opened the skull and the black humus-like substance came out, smelling like good, living soil, the earthenware pot contained the same reddish-brown oak bark that was put in it in October. Nothing had changed. That was an entirely convincing experience. The change in the oak bark was remarkable in the first experiment, while nothing happened to the other preparation.

Nevertheless we made our usual experiment to find the homeopathic influence of the two preparations on plant growth, taking one gram of each, adding 10 c.c. of lukewarm rainwater, and placed the two bottles in the sun. The oak bark which had been buried in the skull, only slightly coloured the water ; whereas the oak bark which had been buried in the earthenware pot made the water clear brown. The oak bark preparation in the skull had lost nearly all its content of tannic acid, the other preparation still contained tannic acid. We proceeded after a few days to potentize the two liquids and later on obtained the following result :

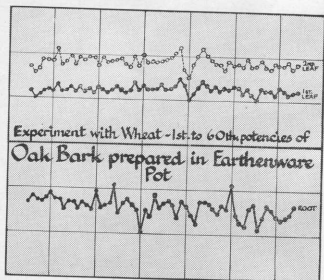


Fig. 184 Wheat plants grown under the influence of 1st-60th potencies of oak bark buried in earthenware pot

The first maximum for the first and second leaf happens at the 7th potency, the second at the 33rd, the third at the 38th potency. There is only one minimum for both leaves at the 35th potency.

The roots have two minima at the 19th and at the 45th potencies, and two maxima at the 25th and 56th potencies.

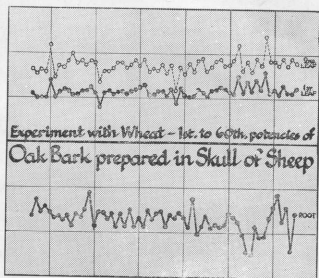


Fig. 185 Wheat plants grown under the influence of 1st-60th potencies of oak bark buried in the skull of a sheep

We notice a great difference between these two graphs. The prepared oak bark is more harmonized. The first maximum is at the 5th, the second at the 47th, and the third at the 53rd potency. There are two minima at the 16th and 33rd potencies.

The roots have three minima, at the 14th, 37th and 56th potencies, and two maxima at the 50th and 59th potencies.

The root growth is much better with the prepared oak bark, especially with the last twenty potencies.

The weight of the dried plants is in favour of the prepared oak bark.

(3.) Tests with Capillary Dynamolysis

If the extract of oak bark rises in filter paper, it produces only an insignificant, wavy border line of light-brown colour. The prepared oak bark is even more insignificant, because it is more lacking in colour. The addition of silver nitrate

produces a quick chemical reaction. The pictures form themselves rather rapidly and consist of intensive reddish-brown colours. Unfortunately these pictures darken also very quickly and then they are completely spoilt.

The addition of iron sulphate changes the pale yellow paper into a strong moss-green and characteristic formations appear.

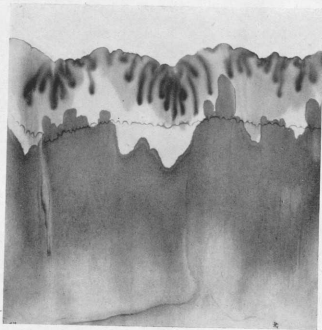
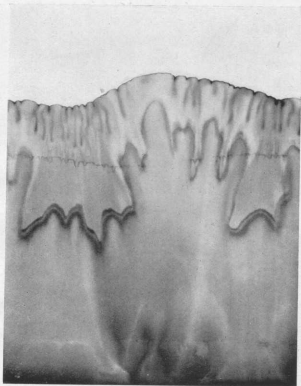


Fig. 186 Oak bark unprepared, followed by 1% iron sulphate

Two different groups of formation are visible on this test. The one going from the bottom of the picture towards the top, the other running from the top down to the first border line formed by the oak bark solution alone.



OAK BARK UNPREPARED
FOLLOWED BY 1% GOLD CHLORIDE



*Fig. 187 Oak bark unprepared, followed by
1% of quicksilver chloride*

The addition of quicksilver chloride also produces a change in the coloration, but it is less strong than with iron sulphate. Across the picture we see the thin border line which had been formed at first by the oak bark alone, then the two streams of forms from the top to the border line, much more delicate than that produced by the iron sulphate, and from the bottom to the top, strong rounded forms—more powerful than in the iron experiment. They are greenish-yellow, framed by clear brown. The original looked beautiful.

But the most beautiful experiment was obtained using gold chloride.

In some ways we are reminded of the forms of quicksilver chloride—only the colours are different. The huge wavy lines are bluish-green, the top of the picture is clear yellow, below the wavy formations, light moss-green. From the bottom to the top, a dark purple, pointed, flame-like form radiates; this has light purple shades inside, which slowly change to orange and some shades of brown.

Less interesting are the experiments with copper sulphate, tin chloride and lead nitrate.

We repeated these experiments with the prepared oak bark and obtained the following results :

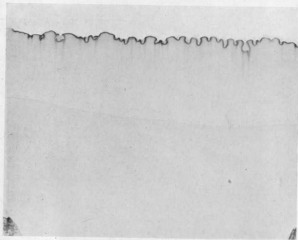


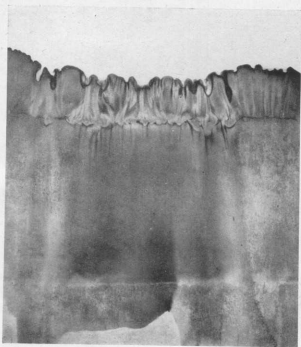
Fig. 188 Oak bark prepared in skull of sheep, followed by 1% iron sulphate

The iron sulphate does not react, there is no change in the colour, no characteristic forms appear.



Fig. 189 Oak bark prepared in skull of sheep, followed by 1% quicksilver chloride

The quicksilver streams through the preformed oak bark picture and nothing happens. No colour appears and no forms, only the rising limit is much higher than in the picture with the unprepared oak bark. Since the experiments are carried out at the same time, the increased rising limit cannot be attributed to external differences, as for instance, an increased humidity in the air, or changed temperature.



*Fig. 190 Oak bark prepared in the skull of a sheep,
followed by 1% gold chloride*

The colours are dark purple, the picture looks dull, and is spotted. We see in the lower parts of the picture that a certain effort has been made to produce some formations, but they are covered with a dark veil.

The experiments with silver nitrate, copper sulphate, tin chloride and lead nitrate were quite insignificant.

The fresh oak bark, and oak bark which has been buried in an earthenware pot, have in themselves a strong formative force, which can be revealed with the different metal salt solutions. This specific formative force has disappeared after the preparation has been affected in the skull of an animal. The bark is changed to a black substance like humus, which is full of life, but has lost its formative force.

Year after year we experienced the same result, in the skull of a cow, or pig, or sheep, or horse. There are slight differences according to the different animals, which are only discernible after comparing results for some years. For instance, we may look at the experiments with oak bark in a sheep skull :

Fig. 191

*Experiment with oak bark
followed by 1% silver nitrate
1929-30*

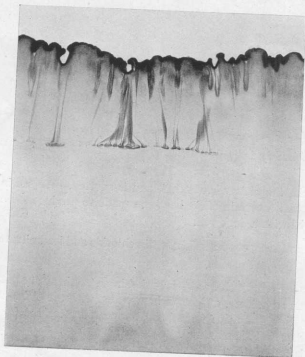
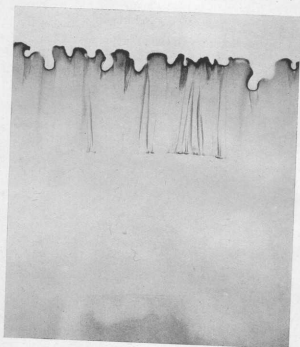


Fig. 192

*Experiment with oak bark
followed by 1% silver nitrate
1930-1*

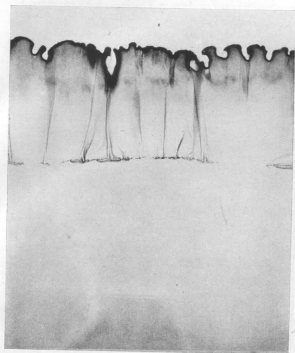


Fig. 193

*Experiment with oak bark
followed by 1% silver nitrate*

1932-3

The similarity is quite astonishing. Year after year we get the same effects.

If we make the preparation of oak bark in the skull of an ox and repeat this experiment, we get the following result :

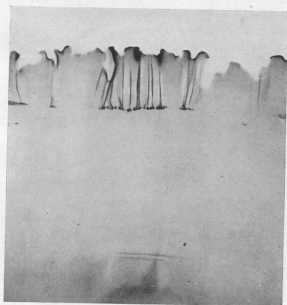


Fig. 194

*Oak bark prepared in the
skull of an ox, 1931-2
followed by 1% silver nitrate*

There is again a great similarity between Figs. 194 and 195, and there are certain differences between them and the sheep skull preparation.

Fig. 195

Oak bark prepared in the skull of an ox, 1934-5 followed by 1% silver nitrate

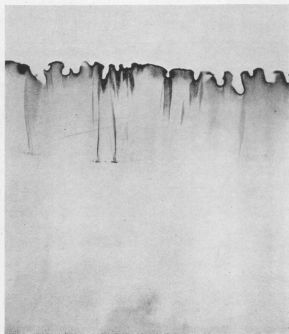
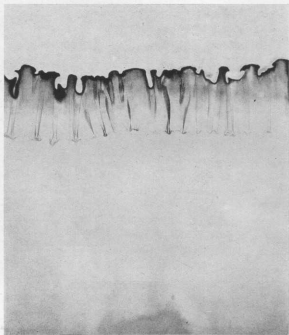
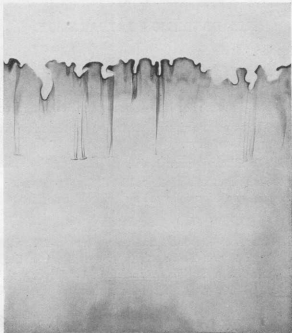


Fig. 196

Oak bark prepared in the skull of a cow followed by 1% silver nitrate



*Fig. 197 Oak bark prepared in
the skull of a horse followed by 1%
silver nitrate*

9 The oak bark is transformed in all the different skulls of domestic animals in a similar way.

We like the preparation in the horse skull the least, as it has an unpleasant smell. All the others are good.

INTRODUCTION

In June 1924 Rudolf Steiner gave a series of lectures to a meeting of farmers and gardeners on Count Karl von Keyserlingk's estate at Koberwitz in Silesia. He spoke about the various problems of agriculture. In the introductory lecture he pointed out how far-reaching the interests of agricultural life are, how nearly all the different branches of human life are connected with agriculture, how many spheres of life are touched by it.

How completely wrong it is only to take into consideration the immediate surroundings of a beetroot or a turnip, for example. For the plant is dependent in its growth on influences which are not to be found on earth, but which are streaming in from the cosmos. We try to arrange and explain many things as though we had only to deal with them within their narrow limits, and not with the whole universe. Already in his first lecture Dr. Steiner sketched a picture of agriculture reaching far beyond our earth, touching the stars. He stressed the necessity of enlarging our knowledge of plant life, animal life, and the life of the whole earth, and of extending it to an intimate knowledge of the whole cosmos.

After his lectures there was always an opportunity for the farmers and gardeners to discuss the different problems dealt with in the lecture, and to ask questions ; it was amazing to hear Dr. Steiner's replies about all their many problems.

Only eight lectures were given, but they contain the fundamental principles for a new agriculture. Some of the farmers and gardeners undertook to start making use of Dr. Steiner's suggestions immediately on their farms. Some time later Dr. Steiner entrusted me with the task of making the necessary scientific investigations. Twenty years have passed and I have tried to carry out as much as was possible. More could have been done if there had been more financial help.

L. KOLISKO.

THE DANDELION PREPARATION.

(1.) Introduction.

(2.) Experiments with Wheat.

(1.) Comparative experiments with wheat plants grown under the influence of 1st — 60th potencies of unprepared Dandelion.

(2.) The same experiment carried out at the same time with prepared Dandelion.

(3.) Tests with Capillary Dynamolysis :

Unprepared Dandelion followed by 1% gold chloride ;

Prepared Dandelion followed by 1% gold chloride.

(1.) Introduction

Rudolf Steiner describes the dandelion as a plant gifted with the capacity of regulating the relation between silicic acid and potassium in the plant organism. If we prepare dandelion in a certain way, and add this preparation in a minute quantity to the manure —or compost heap—then this manure is able to achieve this regulation in plant life.

The preparation suggested for dandelion seems strange. We collect the flowers, let them slightly fade, or dry them (they must not go to seed), press them tightly together, and fill the mesentery of an ox with them. During the winter the mesentery is buried in the soil, so that it is exposed to the strong forces which stream through the soil at this time of the year, and in spring it is ready to be used in the compost heap. Again we need only a very small amount—1 or 2 grams for a medium-sized heap (2·3 cubic yards).

The dandelion is a well-known plant. It has long and deeply serrated leaves which yield a bitter milky juice if we break them. The roots grow downwards deeply into the earth. The large golden yellow flower turns later, when the seeds ripen, into a round ball with long reddish seeds underneath. We find it frequently in meadows and pasture grounds. Culpeper tells us that "this plant is under the government of Jupiter, that it is of an opening and cleansing quality, and therefore very effectual for the obstructions of the liver, gall and spleen, and the diseases which derive from them, as the jaundice and hypochondriac. It opens the passages of the urine both in young and old."

It has been found by chemical analysis that the content of bitter substances varies greatly during the year. The greatest amount of bitter substances is in the leaves in spring, and in the roots between July and August. The most important substance in the root is **Inulin**, the amount of which varies from 1·7% to 24% between spring and autumn ; whereas in spring the roots have a rather large amount of sugar and laevulin, about 17% of each. Therefore if extracts of dandelion are made they will vary greatly according to the time of year.

The ash contains a fairly large amount of silica and calcium.

(2.) Experiments with Dandelion prepared according to
Dr. Steiner's suggestions

Again the question arises : Is there really any difference between ordinary dandelion and the dandelion which has been buried in the soil enclosed in the mesentery of an ox? For many years we studied all these preparations and can truthfully answer : " Yes, there is a great difference if the plants have been treated in these strange ways." Because we have to add all the preparations in a homoeopathic quantity to the manure heaps, we always start the experiments with the test : **how do smallest entities of the preparation influence plant growth ?**

First, we have to make the preparation very carefully. The dandelion is collected, immediately put into the mesentery, and kept until the beginning of October in a cool, dry place covered with peat moss. If we do not get the mesentery in time, the dandelion must undergo a careful drying process. The flowers have to be spread out on filter paper (or any other clean paper) in a warm, dry room. Some will change into seeds, but if we take sufficient care, the rest will be all right.

Never keep the flowers in too thick a layer, or they will become mouldy.

Collect only beautiful specimens, the plants are sufficiently numerous everywhere. We can put quite a large amount of dandelion in one mesentery.

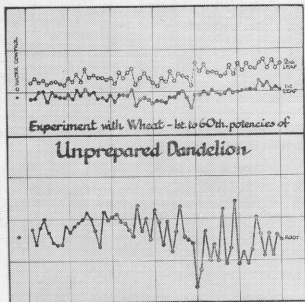
The mesentery must be perfect. Do not use damaged parts with little holes. The surplus fat which surrounds the skin can be cut off and used in the kitchen, we need only the skin. The skin is tender, so we must be careful not to break it. It must be well wrapped round the flowers and then we wind a string round it, or fasten it any other way we find suitable. Dr. Steiner suggested that the plants should be sewn into the mesentery—but it is rather difficult to do this without breaking the skin. It is a nice little package when we have finished, and we see the flowers through the transparent skin.

Again we bury it in good soil about three feet deep and cover it carefully with soil, marking the spot, so that we may find it again in spring.

At about Easter the preparation is finished. The dandelion looks changed, it smells pleasantly, and contains a certain moisture.

For the experiment we take 1 gram of this prepared dandelion and add 10 c.c. of lukewarm rainwater. We keep the bottle well stoppered for two to three days in the sun.

For the second experiment we take the same amount of 1 gram of dried dandelion we had put aside when we filled the mesentery. After a short time the liquid becomes a light brown colour over the prepared dandelion ; the unprepared becomes only slightly yellow. After two to three days we begin to potentize these two extracts and make the usual experiment with wheat.



This graph is not easy to read. We find two minima for the leaves, the 26th and 39th potencies. One maximum is at the 40th potency. As a whole the tendency is an increased growth, especially in the last 20 potencies.

The growth of the roots is very unstable. The first minimum is at the 26th potency, the second at the 36th, the third at the 49th potency. There is one strong maximum at the 40th potency. Also the roots show a definite advance from the 40th to the 60th potencies.

Fig. 198 Wheat plants grown under the influence of 1st-60th potencies of unprepared dandelion extract

The difference between these two graphs is enormous. The prepared dandelion has a perfectly harmonious graph. (Each point in the graph stands for the average growth of 30 seeds which are carefully selected, so that the individual differences are very small.)

First and second leaves have the first minimum at the 12th potency, the second minimum at the 38th and 39th respectively. Almost in the middle of the two minima, forming a symmetrical curve to both sides, lies the maximum at the 26th potency.

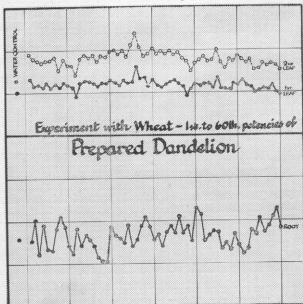


Fig. 199 Wheat plants grown under the influence of 1st-60th potencies of prepared dandelion extract

The roots on the whole are also unstable in their movement. The first minimum occurs at the 40th, and the second at the 59th potency. The maximum is at the 19th potency.

In contradistinction to the unprepared dandelion, the first 20 potencies grow better (unprepared had the last 20 potencies advanced). The preparation has somehow harmonized the forces of the plant.

If we compare these two experiments with their respective weight, we are still more amazed at the difference.

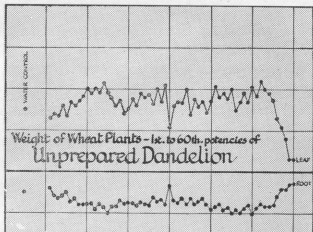


Fig. 200

Weight of the wheat plants grown under the influence of 1st - 60th potencies of unprepared dandelion

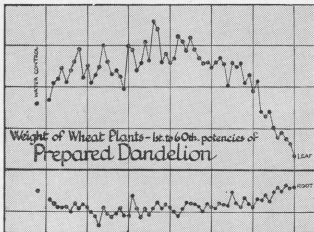


Fig. 201

Weight of the wheat plants grown under the influence of 1st - 60th potencies of prepared dandelion

The unprepared dandelion has a graph of two periods. The minimum at the 30th potency divides it. The first period has the maximum weight at the 14th potency and the minimum at the 19th. The second period is less clear as far as the

minima are concerned. There are three equally strong minima, the 35th, 39th and 46th potencies, and the fourth decisive at the 60th. The maximum is at the 52nd potency, followed by a steady downward movement.

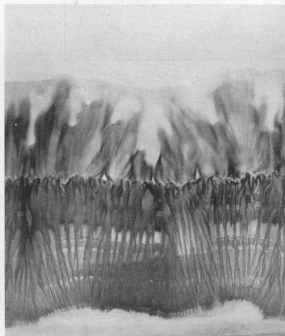
The graph for the roots is beautifully symmetrical in the first period, with the maximum at the 15th potency. The second period has the maximum at the 50th, and the minimum at the 60th potency.

The **prepared** dandelion has only **one** period, with the maximum at the 26th potency and two minima at the 19th and 44th potencies for the leaves. For the roots the maximum is at the 13th potency, two minima are at the 21st and 45th potencies.

On the whole, **the prepared dandelion has increased the weight of the plants considerably** in comparison with the unprepared dandelion.

(3.) Tests with Capillary Dynamolysis

It is not easy to get a really characteristic picture of the dandelion. Much depends on the time when the plants are collected. The best test we ever obtained is shown in the following picture :



*Fig. 202 Extract of dandelion unprepared,
followed by 1% gold chloride*

The dandelion juice itself forms an insignificant yellow border line at about the middle of the picture. The gold chloride develops out of the void these beautiful characteristic forms. An intimate study will convince the reader that much of the characteristic formation of the leaves is hidden in the lower part of the picture. The colours were very bright purple, bluish-purple and yellow, with green on the top. Iron and tin salts gave good results, but the best was gold chloride.

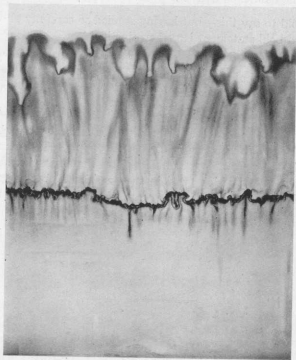


Fig. 203 Extract of prepared dandelion, followed by 1% gold chloride

It is a great pity that we cannot reproduce the original colours. The picture is very clear—it is difficult to describe—but the most truthful description would be to say, it contains more **light**, than the other experiment. **Less strong formative forces, but a stronger, clear, light-power.** There are no dark purple shades, everything is light blue-purple, yellow, and greenish-yellow. The only dark purple line is in the middle, the rising limit of the dandelion juice.

If we compare the rising limit of both juices, then we must say they are nearly identical. It would not be possible to discriminate between the two experiments before the metal salt has passed through. Only the gold can reveal the difference

between the two extracts. The unprepared has more formative forces, but they are mixed with darkness ; the prepared dandelion has lost some of the characteristic formative forces, but has acquired an inner force of light.

We remind the reader of our chapter on **silica**. The specific quality of silica is to enhance the light-forces in the soil. Plants which grow under the influence of silica show similar phenomena to plants which get an excessive amount of light. We are convinced that the differences in the picture are due to the activating of the silica process in the dandelion extract.

It may be bold to say this—but having studied so carefully all these processes for many years—a bold statement is perhaps justifiable.

The gold can carry the prepared dandelion juice higher up than the unprepared. Of course those experiments have been carried out at the same time, in the same room, under perfectly identical conditions as far as light, heat and humidity of the air are concerned.

This preparation added to the manure heap is supposed to help the plants to find the right relationship between silica and potassium. The manure will enable the soil to take in the right amount of silica from the atmosphere and cosmic surroundings, and the plants which grow in such a soil will become sensitive to the presence of silica in their surroundings and will have the capacity to use it in the right way.

THE CAMOMILE PREPARATION.

(1.) Introduction.

(2.) Experiments with Wheat.

(1.) To study the homoeopathic effect of this preparation on wheat plants from the 1st to the 60th potencies.

(2.) The same experiment carried out with unprepared camomile.

(3.) Tests with Capillary Dynamolysis: prepared camomile followed by 1% of gold chloride ; unprepared camomile followed by 1% of gold chloride.

(1.) Introduction

Rudolf Steiner suggests **Camomile** (*Matricaria chamomilla*) for the regulation of the **calcium process**. Camomile has a homoeopathic content of sulphur which enables it to regulate the intake of calcium. If we prepare camomile flowers and add them to the manure, we enable the manure to assimilate so many life-forces that they can be transmitted to the soil for the benefit of the plants. The manure heap must not only have life, it must also be in such a condition, that it can be distributed in the soil. Rudolf Steiner suggests studying the influence of camomile on the human body. Milfoil acts on the kidneys, not so the camomile. This plant is more effective in the intestines. It is a very well-known remedy for "all pains and torments in the belly" (according to Culpeper's herbal the old Egyptians dedicated camomile to the Sun). "The bathing with a decoction of chamomile taketh away weariness, easeth the pains to what parts soever they be applied. It comfortes the sinews that be overstrained, mollifies swellings ; it moderately comforteth all parts that have need of warmth, **digesteth** and **dissolveth** whatsoever has need thereof by a wonderful speedy property ; it eases all the pains of the colic and stone and all torments of the belly." "It is profitable for all sorts of agues that come either from phlegm, or melancholy, or from inflammation of the bowels."

We can easily understand, that we must not put the camomile flowers into a bladder, as we do milfoil,* but in that organ which is more related to the whole camomile process : the intestines. We need the intestines of an ox for this purpose.

The camomile plant grows everywhere in the meadows, blooms from May to June and exhales a characteristic aroma. The name *matricaria* is derived from the Latin **mater** (mother) and indicates that the plant has been used to ease the pains of childbirth. Although this plant is known everywhere, people often do not discriminate between *chamomilla matricaria*, and other wild species ; but for our preparation it is essential to use only the *chamomilla officinalis*, or *matricaria*.

* See the chapter about the milfoil preparation.

How to make the preparation for the manure

We gather the beautiful white flowers in May or June (only the flower heads) and dry them carefully on paper, spread out in thin layers. The plant dries rather quickly and beautifully. Then we may keep it in paper bags or glass jars, well closed so that the etheric oils do not evaporate until autumn. At the beginning of October we try to obtain fresh intestines from the butcher, and again it is better not to wash them. They are not pleasant to handle, but after a time we overcome our distaste. First we wind some twine round the intestines to close the opening, then cut off a piece about 10 inches long and press the camomile in from this end. We make a well-shaped "sausage," and wind another thread round to shut the opening. After doing this for some time, we have the distinct feeling that we are doing a quite natural thing; the sausages look pleasant and smell nice, and somehow the plant and this organ seem to belong to each other. The ox could have eaten the camomile flowers in the meadows and have them quite naturally in its intestines. Only in that case they would have passed through the stomachs and would have undergone a part of the digestive process in the organism of the animal. **We need only that part of digestion which takes place in the intestines** and not the whole digestive process, where part of the plant-forces are absorbed by the animal organism for its own use, and only the remainder goes into the intestines to be excreted.

We bury these "sausages" during the winter in good soil and have the finished preparation in spring, ready for use in our manure heaps. It is good to choose a place for burying the camomile sausages where snow may cover the soil during winter and later on the sun can shine on the snow-crystals and melt them away. We need all the cosmic forces both below and above the soil for the perfection of this preparation, which later on helps to retain the **nitrogen** in the manure and to raise a healthy crop.

If we have taken sufficient care in making and burying the "sausages," we can dig them up in the spring unharmed; and again we need only a tiny amount of this prepared camomile for the manure heap: 1-2 grams for a medium-sized heap.

Experiments with prepared Camomile

Again, the first experiment is to discover the homoeopathic effect of this preparation. We take 1 gram of the prepared camomile, add 10 c.c. lukewarm rainwater, and place the bottle in the sun for a few days. The same is done with 1 gram of camomile flowers kept in a glass jar during October-March in the laboratory. We observe the different colour of both extracts. The camomile which has undergone the preparation in the intestines has a darker coloured juice than the unprepared. From these extracts we make the potencies (up to the 60th) and then allow wheat to germinate and grow for a fortnight in these potencies.

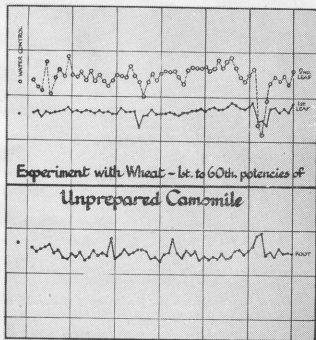


Fig. 204 Wheat plants grown under the influence of 1st-60th potencies of unprepared camomile

It is a very clear, harmonious graph, which we can easily understand. The first maximum for the second leaf happens at the 9th potency, the second at the 46th. The first leaf does not indicate the maximum growth. The first minimum for the first leaf happens at the 25th, the second at the 54th potency (52nd, 53rd and 54th). The second leaf has the first minimum at the 26th and the second at the 53rd potency, but also the 52nd and 54th potencies are very close to the minimum.

The roots indicate three minima : the first at the 19th, the second at the 33rd and the third at the 53rd potency. There is no maximum growth.

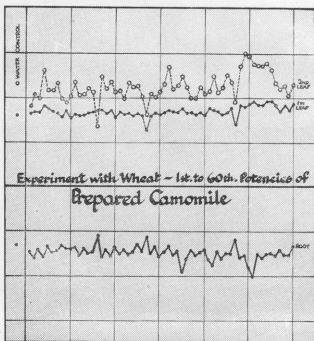


Fig. 205 Wheat plants grown under the influence of 1st-60th potencies of prepared camomile

At the first glance this graph seems similar to the previous one, but actually there are great differences.

The first maximum occurs earlier, at the 4th potency (for the second leaf), the second maximum is at the 32nd, and there is a third maximum at the 49th potency. Also here we see that the first leaf does not indicate the maximum growth, only the second. We have also three minima: the 16th, the 27th and the 47th potencies. Both leaves have the same minima.

The roots show three minima: the 16th, 27th and 47th potencies. They coincide with the minima of the leaves. We have also a maximum growth in the roots at the 35th and 51st potencies.

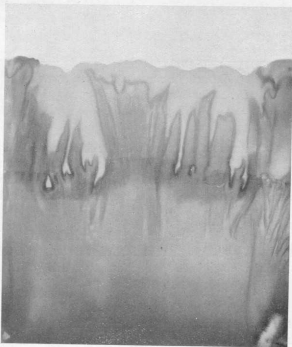
The more intimately we study these two graphs, the more differences we find. The preparation of the camomile has produced a greater harmonization of its forces. The unprepared camomile has discrepancies between the first and second leaf formation of the minima, also the root changes the position of the minima, whereas the prepared camomile is perfectly balanced. In the prepared camomile there is also an opposite movement in the final potencies. Where the one graph shows maximum growth, the other descends to its minimum. The unprepared does not produce maximum growth in the roots, the prepared does, and so on.

The comparison of **weight**, proved a considerable increase of weight in the prepared camomile.

(3.) Tests with Capillary Dynamolysis

For camomile we prefer the experiment with an addition of gold chloride to all the other metal salt combinations. The procedure is the usual one. We extract 1 gram of the prepared camomile with 10 c.c. lukewarm rainwater and keep it in the sun for a few days, then compare it with 1 gram of dried camomile flowers which have the same age, and have been kept in glass jars in the laboratory.

The extracts rise equally high in the filter paper and produce an insignificant slightly yellow border line. There is no difference to be seen between these two extracts. We add the various metal salt solutions and the differences become evident to every unprejudiced observer.



*Fig. 206 Extract of the unprepared camomile
followed by 1% gold chloride*

THE MILFOIL PREPARATION.

(1.) Introduction.

(2.) Experiments :

- (1.) Test with Capillary Dynamolysis of the urine of a stag
- (2.) Test with Capillary Dynamolysis of the urine of a stag followed by 1% silver nitrate
- (3.) Test with Capillary Dynamolysis of the urine of a stag followed by 1% quicksilver chloride
- (4.) Test with Capillary Dynamolysis of the urine of a stag followed by 1% copper sulphate
- (5.) Test with Capillary Dynamolysis of the urine of a stag followed by 1% gold chloride
- (6.) Test with Capillary Dynamolysis of the urine of a stag followed by 1% iron sulphate
- (7.) Test with Capillary Dynamolysis of the urine of a stag followed by 1% tin chloride
- (8.) Test with Capillary Dynamolysis of the urine of a stag followed by 1% lead nitrate
- (9.) Reversed method : 1% silver nitrate followed by stag's urine.
- (10.) Similar experiment with another stag
- (11.) Similar experiment with another stag
- (12.) Similar experiment with diseased stag
- (13.) Test with Capillary Dynamolysis of the urine of a male fox.
- (14.) " " " " " " " female fox.
- (15.) Experiment with wheat to study the homoeopathic effect of milfoil kept in the bladder of a pig
- (16.) The same experiment carried out with milfoil kept in the bladder of a male fox
- (17.) The same experiment carried out with milfoil kept in the bladder of a stag
- (18.) The same experiment with unprepared milfoil.
- (19.) The same experiment carried out with one-year-old preparation of milfoil
- (20.) The same experiment carried out with an eight-year-old preparation of milfoil

- (21.) Weight of wheat plants grown under the influence of 1st-60th potencies of unprepared milfoil
- (22.) Same experiment with prepared milfoil (one-year-old preparation)
- (23.) Same experiment with prepared milfoil (eight-year-old preparation)
- (24.) Test with Capillary Dynamolysis of unprepared milfoil followed by 1% gold chloride.
- (25.) Test with Capillary Dynamolysis of prepared milfoil (one-year-old preparation) followed by 1% gold chloride
- (26.) Test with Capillary Dynamolysis of prepared milfoil (eight-year-old preparation) followed by 1% gold chloride

(1.) Introduction

Everybody knows this plant **Milfoil**, or **Yarrow**, or **Achillea Millefolia**. It grows in our pasture grounds and along the hedgerows. It has many leaves cut into a multitude of fine small parts. The leaves are of a deep-green colour. The stalk is greyish-green and the small flowers usually white, but we often find among them others of a delicate pink. It blooms generally from August to the middle of September, and Culpeper tells us, that this plant is under the government of the planet **Venus**.

The name **Achillea** points to the connection with the Greek hero Achilles. We are told that Achilles had been taught the use of this plant by the great **Chiron**. Achilles had taught it to Patroclus and healed King Telephus, who was badly wounded. In antiquity Milfoil was used to stop bleeding. It has also had the name "stratiotes" which means "herb of the soldiers."

In the Middle Ages we find this plant named "supercilium Veneris": "the eyebrows of Venus." It was used to purify the blood, to stop interior and exterior bleeding. It was a popular remedy for liver and kidney troubles, deficiency of the bladder, weakness of the digestive organs, etc. Externally it was used for compresses on wounds or ulcers; and in the bath for rheumatism.

Yarrow contains bitter substances and therefore has been used instead of hops for making beer.

The chemical analysis proves that the leaves of milfoil contain a certain amount of prussic acid, a nitrogenous bitter substance tannic acid, Achillea acid, which is considered identical with aconite acid, and various nitrates. In the roots traces of sulphur have been found. The leaves contain more of the bitter substances, the flowers more of the oily substances. There are also aromatic oils in the roots which smell like valerian. The oil which is distilled from the dried herb contains vineol, pinene, limonene, thujone, borneol, camphora, caryophyllin, azulene, acetic acid, isovalerian—and formic acid ester, eugenol, methyl and ethyl alcohol, formaldehyde, acetone, furfural. We must be thankful that our scientific methods are able to find all these details. Yarrow is such an insignificant plant—and yet so many substances work in it.

Rudolf Steiner emphasizes, that the milfoil is a plant in which sulphur plays a specific role. Sulphur is in an ideal relation to the other substances.

The chemical analysis of this plant reveals that there is sulphur in the roots.

Rudolf Steiner suggests taking the flowers of milfoil and enclosing them in the bladder of a stag and hanging this bladder in the sun during the summer. During autumn and winter it has to be buried in the soil, not too deeply. The following spring the preparation is finished and may be added in a small amount to enliven the manure heap.

This suggestion may seem very strange. The cow manure must be enclosed in a cow-horn to concentrate its power (see Chapter I). The flowers of milfoil must be enclosed in the bladder of a stag. We find that in medicine this plant is considered to be a remedy for kidney troubles and deficiencies of the bladder—so there **must be a relationship between this plant and the process taking place between the kidneys and the bladder.**

The most prominent feature in a stag are the antlers. They give this animal a kind of majestic beauty. The stag is not such a phlegmatic animal as the cow—it is a very nervous creature. If we have ever had the opportunity of watching a stag in its natural surroundings, we see that it uses its antlers as sense organs, far-reaching sense organs, with which it communicates with the environment. The antlers are the weapons that stags use when they fight each other for the rulership of the herd.

Wherever the organism produces a horny layer (as was mentioned in the chapter about the cow), that is a sign that certain forces which stream out of the organism through the skin, are pushed back and reflected into the inner organism. But if we look at the antlers of a stag we get the impression that there certain forces are radiating outwards from the inner organism into the surroundings. It is different in the case of horns ; here forces are pushed back. They revert to the inner organism. The form of the wide-spreading antlers indicates the opposite stream of forces ; the stag lives more in connection with its surroundings. All animals which have antlers, are " nervous." We can even see it in their eyes. What a difference there is between the expressionless staring of the cow, and the furtive glance of the stag, who is always prepared to flee, to escape into the solitude of the forest. The slightest noise frightens these animals—when a cow would not even turn its head.

Our task was to find out why it is necessary to use the bladder of the stag. What are the specific qualities of this organ?

We tried to obtain a stag's bladder as soon as possible after it had been shot. Fortunately we knew a forester who was interested in our researches, and sent us the bladder immediately after the stag was killed. But we did not only want the stag's bladder—it had to be sent in perfect condition with its contents. We desired to study the formative forces of the urine by means of capillary dynamolysis.

(2.) The Urine of a Stag

The excretion of the stag has quite a pleasant smell. We made as many experiments as possible with the amount of urine which was at our disposal. We got a fairly large bladder containing about 200 c.c. urine. Fig. 208 represents the picture we had from the urine alone.

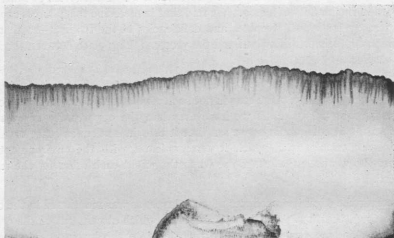


Fig. 208 Urine of a stag

It did not rise very high, the border line was coloured yellow with tiny waves, intersected by sharp pointed short lines. We made a large series of similar pictures and began to add the various metal salt solutions.

Fig. 209

*Urine of a stag followed
by 1% silver nitrate*

This is a very characteristic formation. At the top of the picture delicate plant-like structures, of pale greenish-yellow colour, are met by a dark frame of brown silver contours.

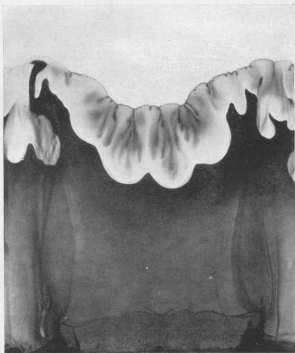
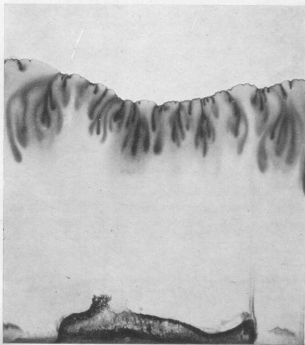


Fig. 210

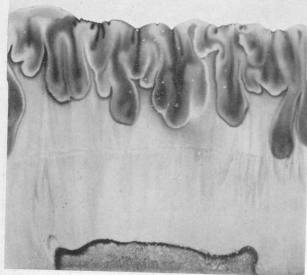
*Urine of a stag followed
by 1% quicksilver chloride*



This picture looks less powerful. At the top we find plant-like structures, similar to those produced with nitrate of silver.

Fig. 211

*Urine of a stag followed by
1% copper sulphate*



This experiment again is very interesting. The copper sulphate has changed the plant-like structures at the top, and each group is surrounded by a bluish-green copper line. The top is slightly yellow, the darker shades are a delicate green. The original was very beautiful and gave the impression of being moulded; this is even obvious to a certain degree in the photograph.

Fig. ~~212~~ 213

*Urine of a stag followed by
1% gold chloride*

The plant-like structures at the top are similar in strength to those developed with the help of copper sulphate, but they are not framed in. The lower part of the picture is less due to the urine as far as the forms are concerned. The colours in the original were clear and bright; the gold could display its own beauty.

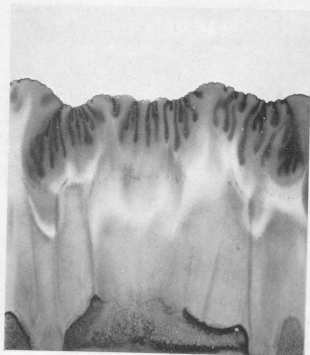


Fig. ~~212~~ ²¹²

*Urine of a stag followed by
1% iron sulphate*

The top line shows the same plant-like structure as the previous experiments. The outer contours are more veiled and blunt. The lower part is moss green, due to the reaction of iron with the tannic acid contained in the urine of the stag.

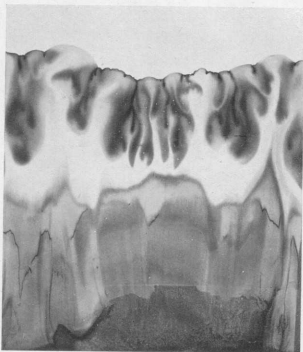
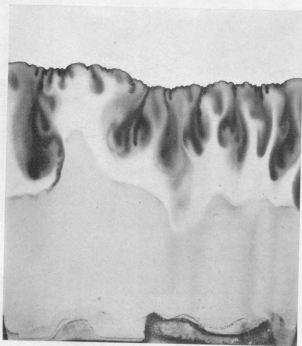


Fig. 214

*Urine of a stag followed by
1% tin chloride*

The tin again forms the upper part much more clearly than the iron; the lower part is insignificant.



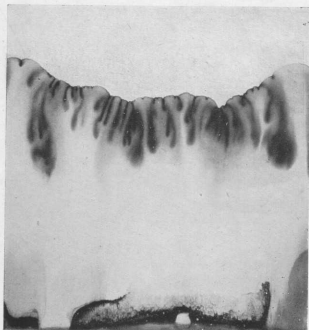


Fig. 215

*Urine of a stag followed
by 1% lead nitrate*

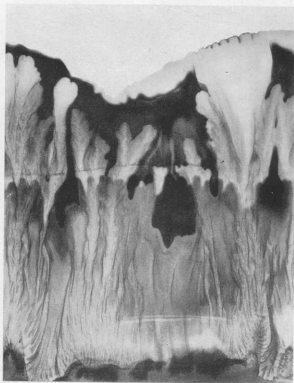
This metal salt produces the least clear picture of the whole series.

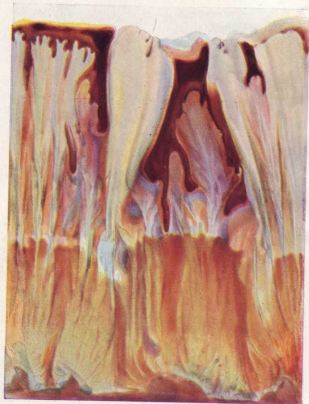
If we had to choose according to the characteristic formations we should select in the first place the experiment with copper, in the second the experiment with silver, then gold, tin, iron, quicksilver and lead.

The next series of experiments is carried out with the reversed method (see Part II, Chapter VII). We first use the nitrate of silver, then add the urine. Here we get the most marvellous effect possible. The stag reveals itself in its specific formative forces.

Fig. 216

*1% Silver nitrate followed
by urine of the stag*





1% SILVER NITRATE
FOLLOWED BY EXCRETION OF A STAG

It is scarcely necessary to describe this picture. The nature of the stag is inscribed so clearly, that often when we had the opportunity of showing visitors the original experiment and asked : what do you think has been used here? It is the excretion of an animal, but which animal do you think? The unprejudiced visitor exclaimed : " Well, I would guess it is a stag, a deer. But how could you get the urine of a stag? It looks like antlers."—That is perfectly true.

Our Capillary Dynamolysis reveals that there is actually a connection between the antlers and the excretion. The same formative force streams through the kidney system, penetrates the urine, and may be revealed with the help of our subtle method. Now we can imagine that the milfoil flowers which we enclose in the bladder of the stag, undergo a specific process of fermentation, if those radiating forces are kept intact.

We made similar experiments with many stags and the characteristic " antler " formation is always visible. To prove that our statement is true, two more examples out of a great quantity of material are given here.



Fig. 217° 1% Silver nitrate followed by urine of a stag

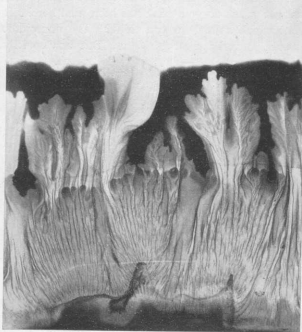


Fig. 218

*1% Silver nitrate followed
by urine of a stag*

Once by chance we had the bladder of a stag which was diseased. The bladder was rather small, hard to the touch, and later we found a dermoid cyst inside. The smell of the urine was less pleasant than usual, and our capillary dynamolytical test had the following result :

Fig. 219

*1% Silver nitrate followed
by the urine of a diseased
stag*



The urine is unable to act in the way a healthy stag's excretion would do. Of course we did not use this bladder for the milfoil preparation. It could not produce a healthy influence on the fermentation of a manure heap.

It is essential for a good preparation to use a fresh bladder. We know that many mistakes are still made by those who get the stag's bladder in a dried condition. The dried bladder looks quite clean, and it is perhaps more convenient to handle—but has lost many of the essential forces. We will refer to this in greater detail later on.

Always in making this preparation we try to obtain the bladder with its content; then open it, empty it, and immediately fill it with milfoil. It is not so unpleasant to handle if we try to understand what wonderful forces we are learning to master, and we easily forget that our hands are touching a bladder and come into contact with urine. "All is not gold that glitters," and all is not dirty that smells. Then we hang the bladder somewhere in the sun. We soon find out that the birds like to peck into it, and we must protect it by surrounding it with a wooden frame covered with muslin. In October we bury the bladder, taking great care not to damage the thin skin. A hole is dug, about one foot deep, in good soil; we remove every stone, place the bladder in the hole, and cover it carefully with soil.

Next spring the milfoil is ready to be used. We find the plant changed. A faint smell like that of the stag's urine impregnates the whole content. If we have handled the preparation with sufficient care, the skin is still unharmed, and we prefer to keep the milfoil in the bladder, taking out only the tiny amount we need for the manure heap. It is not more than what we can take between our fingers.

How to discover, that the prepared milfoil is different from the unprepared :

We have studied the whole problem very carefully for some years. There are many points about which we wish to become quite clear. Perhaps the first question may be : does milfoil influence plant growth at all if used in such a small amount? The answer has been given in the chapter on "smallest entities."

It is impossible to include here all the experiments carried out, but at least mention can be made of what we have done in testing the influence of milfoil in different concentrations. We studied, therefore :

- (1.) *An extract of the fresh green leaves* with rainwater, potentized to the 60th potency.
- (2.) *An extract of the fresh flowers* with rainwater, potentized to the 60th potency.
- (3.) *An extract of the whole herb* with rainwater, potentized to the 60th potency.
- (4, 5, and 6.) the same experiment carried out with the dried plant.
- (7.) An alcoholic extract of the herb potentized with rainwater to the 60th potency.

These experiments gave a good basis for judging whether there is a difference to be found between the influence of "unprepared" milfoil potencies; and milfoil which has undergone the process of fermentation in the bladder of a stag, exposed

to the forces of the sun in summer, and to the terrestrial forces during winter beneath the surface of the soil.

In reviewing all these experiments we must admit that a difference is to be seen in the whole character of the charts obtained. It is especially noticeable that the prepared milfoil influences the growth of the roots. The higher the potencies, the stronger the effect.

The next problem is what would happen if we did not use the bladder of a stag, but that of another animal? Would it be just the same to enclose milfoil in the bladder of any animal whatsoever?

We think that this question is answered by looking at the picture obtained by Capillary Dynamolysis. These experiments show definitely that the stag's urine is of a **unique quality**. Neither the cow, nor the horse, nor the pig have similar radiating forces. Still, to be perfectly sure, we make a comparative experiment.

Comparison between milfoil kept in the bladder of a stag, pig, fox (male and female)

Fortunately in the year 1934 we obtained not only the bladder of a stag, but at the same time, immediately after the killing, the bladders with their contents, of a male and a female fox.

It was easy to get the bladder of a pig, with its contents. At first we made the test with Capillary Dynamolysis and had the usual pictures for the stag's and pig's urine. The fox did not prove successful with the addition of nitrate of silver, but quite characteristic formations with gold chloride were obtained.

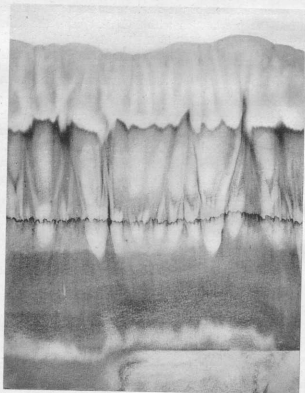
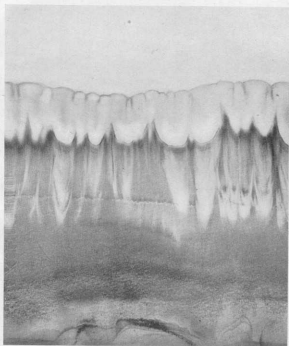


Fig. 220

*Urine of a male fox followed
by 1% gold chloride*



*Fig. 221 Urine of a female fox followed by
1% gold chloride*

The more animals we studied, the more we were convinced, that the stag's urine possesses unique radiating forces.

The flowers of milfoil were put into the different bladders, then kept under different frames covered with muslin in the sunshine, and between October and March they were buried one foot deep, beneath the surface of the soil.

The next year (1935) we started the experiments to potentize the different milfoils. Each of the different preparations smells according to the bladder used. The smell of the pig's bladder is not very agreeable, that of the fox has a more stinging quality, and there is the pleasant resinous smell of the milfoil kept in the stag's bladder. The extract is made in the following way : 10 grams of the milfoil and 100 c.c. rainwater are put in a clean glass bottle and exposed to the sun. From time to time the liquid is vigorously shaken. After three days the extract is ready to be used. It is surprising to see the different colours of the various extracts ; that from a pig's bladder is somewhat cloudy and light-yellow ; milfoil kept in a stag's bladder is clear and light brown. From these extracts we again made pictures with different metal salt solutions and also made potencies up to the 60th potency. We obtained the following results :

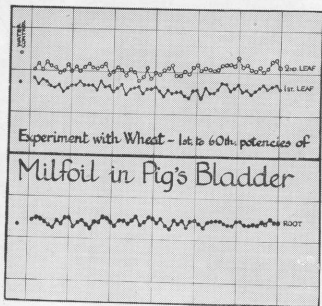


Fig. 222

Wheat plants grown under the influence of 1st-60th potencies of milfoil kept in pig's bladder

It is an harmonious looking graph, indicating maximum growth in the higher potencies (50th and 59th). The minima are scarcely distinguishable. There is not much variety in this graph.

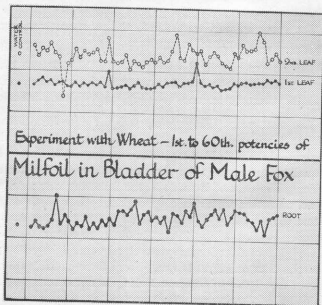


Fig. 223

Wheat plants grown under the influence of 1st-60th potencies of milfoil kept in fox's bladder (male)

Much more is to be seen here. The movement is characteristic so far, in that the growth of the first leaf runs on a more or less even line, suddenly interrupted by a jump to maximum growth (19th and 40th potencies). The water control plants show that for the most part the first leaf remains within the limit of "water," the higher potencies are definitely better than the control and the maxima are beyond doubt.

The second leaf shows a very early minimum at the 8th potency. It is a very strong minimum which lies even beneath the growth of the first leaf. We find three maxima. The first one coincides with the maximum of the first leaf (19th potency), the second appears earlier (35th potency) and the third (55th potency) has no counterpart in the first leaf.

The water control plant for the second leaf shows that many potencies are below the level of the control, that the minimum is far smaller than the control, and the three maxima show decidedly enhanced growth.

The growth of the roots is for nearly the whole series of potencies much smaller than the water control plant indicated. So we must say that the milfoil kept in the fox's bladder has not a favourable influence on the growth of the roots. The first minimum (7th potency) does not coincide with the minimum of the second leaf, the second (26th potency) has no counterpart in the growth of the leaves, the third (40th potency) is the only one which coincides with the first leaf—only there we have a maximum. The maximum is at the 34th and the second maximum at the 57th potency. They also do not coincide with maximum growth in the leaves.

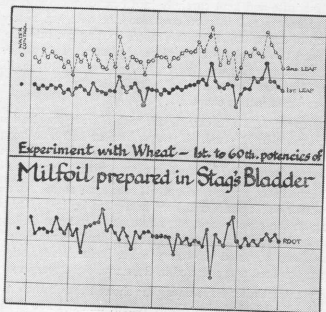


Fig. 224 Wheat plant grown under the influence of 1st-60th potencies of milfoil kept in stag's bladder

The first leaf has the first maximum at the 21st potency ; the second at the 43rd potency ; and the third at the 56th. Minima are at the 27th and 49th potencies. At the beginning the plants are at the same level, or sometimes below the water control plant ; the higher potencies are much more advanced in growth.

The second leaf has the maxima at the same potencies, 21st, 43rd and 56th. Also the minima coincide (27th and 49th potencies).

The growth of the roots shows as minima the 18th and 49th potencies ; as maxima the 13th and 44th potencies. At the beginning the roots are below the water level, then they are much advanced.

Such a short description of the graphs is of course insufficient ; we must leave it to the reader to study them intimately. The graphs are the pictures of living forces working in plant growth, if we earnestly try to understand their language. That takes time, and here we can only point out the direction in which it is useful to begin the study.

Rudolf Steiner said that this milfoil can be kept as long as one likes. According to the size of the bladder, quite a large amount of milfoil preparation may be made, and we need only a tiny amount for one manure heap. So it may be interesting to know for certain **how long such a preparation may be kept**. This preparation is especially precious, for we may have difficulties in obtaining stag bladders.

We report one more experiment, carried out here in England in 1939. To answer the above question, I used milfoil which had been kept in the original bladder from 1931 until 1939, so that it was **eight years old**. It was made in Germany in the Biological Institute and kept carefully in a box, covered with pulverized peat moss. The bladder was still in good condition, the skin was nearly intact. We took out 1 gram of dry milfoil through a small opening cut into the bladder, and immediately closed the opening with a piece of plaster. This was essential. The content still smelt faintly like the stag's urine. We added 10 c.c. lukewarm rain-water to the milfoil, and placed the bottle in the sun, as described for the other experiments mentioned in this chapter.

The second experiment was carried out with a fresh preparation (1 year old) which had been made in England. The stag bladder had been acquired in a dry condition, without the urine in it. The smell of the bladder was very faint, and the milfoil extracted from it did not smell so characteristically as that of the old one.

The third experiment was carried out with the same amount of milfoil collected one year previously in England, and kept in a glass jar in the laboratory. Thus we could compare the effectiveness of milfoil which had not undergone any preparation, but which came from the same place and had the same age, as the second one, which had been prepared according to Dr. Steiner's suggestions. The third milfoil had been prepared and collected in Germany, eight years ago.

The watery extract after three days time showed the characteristic differences. The unprepared milfoil looked clear, light yellow, and did not smell at all. The one-year-old preparation of milfoil was a slightly darker yellow, but not very different,

and smelt faintly disagreeable. The eight years old preparation which had been inserted into a perfectly fresh bladder immediately after the liquid was removed, had a rather dark brown colour and smelt pleasantly. From each of these extracts 60 potencies were prepared, and three series of experiments were carried out at the same time.

Fig. 225 represents the graph for the experiment carried out with the unprepared milfoil.

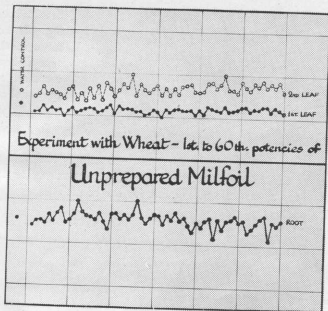


Fig. 225 Wheat plants grown under the influence of 1st-60th potencies of unprepared milfoil

There are two maxima to be seen in the second leaf, the 24th and the 46th potencies. The roots have two minima at the 12th and 26th potencies, two maxima, the 44th and 57th potencies and on the whole we might say that with increasing potencies, the growth also increases. If we divide the graph in two phases, we might take for the first half the 19th potency as a smaller maximum between the two distinct minima.

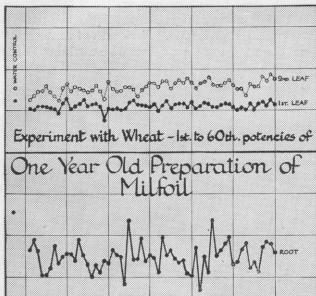


Fig. 226

Wheat plants grown under the influence of 1st-60th potencies of milfoil kept in stag's bladder (one-year-old English preparation).

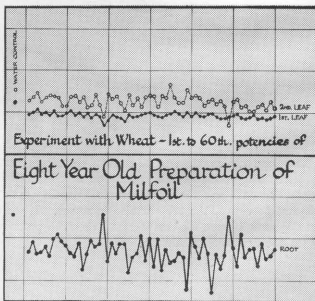
This graph is at the first glance disappointing. There is a minimum at the 19th potency, then the plants increase, but we miss the usual distinct maxima.

The roots are very well developed, they are exceedingly long and strong. We find two minima at the 25th and 45th potencies; two maxima, at the 24th and 42nd potencies. It is a unstable movement for the roots.

Fig. 227

Wheat grown under the influence of 1st-60th potencies of milfoil kept in stag's bladder (eight-year-old preparation)

This graph is more distinct. We have the first minimum at the same potency (19th) for the first and second leaf, and a second minimum at the 49th potency. There is one maximum at the 35th potency.



The roots are also very well developed, and the minima coincide with the minima for the leaves (19th and 49th potencies). There are two maxima at the 39th and 45th potencies, but the movement is exceedingly restless.

It is difficult for an inexperienced person to judge these three charts for the measurement. With our many years experience we do not hesitate to declare that the best result is obtained with the eight-years-old preparation. Still we will try to find a more obvious result for these experiments by taking the weight for each potency.

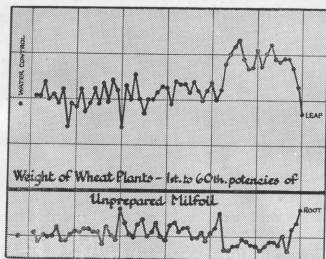


Fig. 228 Weight of wheat plants grown under the influence of 1st-60th potencies of unprepared milfoil

The weight divides the graph into three parts. Between the 40th and 60th potencies the plants are much heavier, the leaves as well as the roots. The leaves have two minima at the 8th and 20th potencies. The roots have two minima 20th and 42nd potencies, and two maxima, 43rd and 57th potencies.

It is interesting to see that the highest potencies enable the plants treated with them to **put on weight**. Weight is not due to the material influence of some substances added as "plant foods," but to the action of an immaterial force.

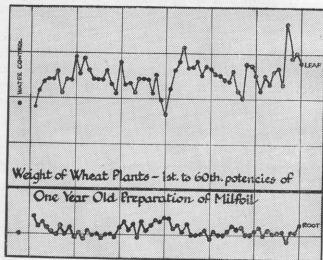


Fig. 229 *Weight of wheat plants grown under the influence of 1st-60th potencies of prepared milfoil (one-year-old preparation)*

This graph is perfectly clear. It is divided into two parts. The first period for the leaves has the maximum between the 10th and 12th potencies, the minimum is the 30th potency. The second period has a smaller maximum (but bigger than that of the first period) at the 34th, and a very high maximum at the 57th potency.

The roots look very harmonious (it is amazing to compare the weight with the measurement of the roots); the minimum is between the 30th and 31st potencies. It is a strange phenomenon which happens again and again that the weight may be opposite to the measurement. (All these phenomena can be explained in detail, if once the opportunity arises to publish all our experiments dealing with the problem of "smallest entities." These researches were started in 1919 and an immense amount of material has been collected.) The restless movement of the roots has disappeared, the more smooth graph for the leaves has become full of life. We see distinct maxima and minima. The long roots have not much weight, the same leaves are rather heavy.

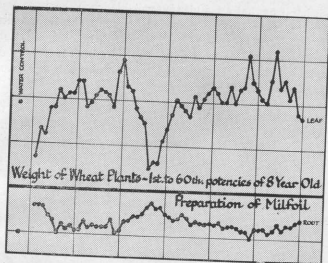


Fig. 230 Weight of wheat plants grown under the influence of 1st-60th potencies of prepared milfoil (eight-years-old preparation)

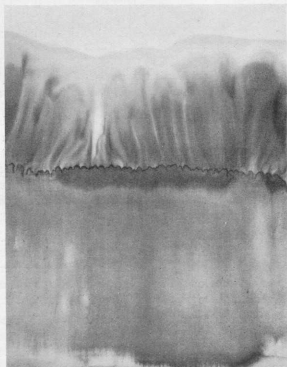
Here also the graph is divided into two periods, the first one having the maximum weight at the 20th potency, and minimum between 26th and 28th potencies. The second period has two maxima (48th and 54th potencies). The roots show the same harmonious movement as Fig. 227, but they are more distinct in forming maxima and minima. The minimum divides the graph into its two periods (27th potency). The first period has two maxima, the 6th and 19th potencies; the second period has one maximum at the 49th potency.

The eight-year-old preparation is stronger in its effects than the one year old. We hold this to be entirely due to the fact that the bladder has been used in a perfectly fresh condition, shortly after the stag has been killed. On the other hand the graph for the weight proves that the one-year-old preparation is very similar. It is also a good preparation, with much power of vitalizing plant life, but it could be better.

Once more we recommend everybody who wishes to make this preparation for himself, to try and get the bladder fresh with the content. Exchange the natural content of urine for the milfoil as quickly as possible, so that the living process of this organ is not too much disturbed. Never wash the bladder outside or inside. Here we must try to preserve the natural condition as far as possible. Fill the bladder well; the milfoil can be pressed without damaging the organ; then wind a thread round the opening and close it tightly. The bladder should smell inside. If an organ exudes an odour, that is a sign that forces are streaming out, and are leaving the organ. The bladder must exude these forces into the milfoil, which is enclosed within it. The bladder has to ferment the milfoil, to penetrate it with those marvellous radiating forces which are revealed by the capillary dynamolytical test.

Sometimes it happens that a bladder is available when there are no fresh plants at hand. In this case we may take the dried flowers. These are a little stiff and could damage the skin of the bladder. We avoid this (the bladder is useless if there are tiny holes in it) by making a tea from the green milfoil leaves, or dried leaves, the dried flowers are soaked in this tea, then they become soft again and can easily be filled into the organ.

The last test we made with the above three preparations was the capillary dynamolytical one.

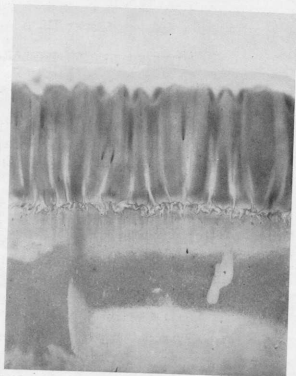


*Fig. 231 Unprepared milfoil, 1 year old,
followed by 1% gold chloride*

The first picture is rather dull. The colours are dark purple and light purple. The top line is yellow with some green shades.

*Fig. 232 Prepared milfoil,
1 year old, followed by
1% gold chloride*

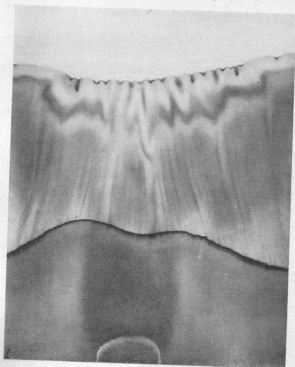
The second picture is clearer, the colours are brighter, and some radiating forces are visible in the upper part.



The third picture is the best. The original was very beautiful in colour and form. The radiating forces are fully developed. Also these experiments indicate that the old milfoil is the strongest.

It is interesting that we are able to use such a well prepared, precious substance even after eight years have passed. Therefore it is well worth while spending money and time to make it quite perfectly. We can never get any artificial fertilizer which is **so cheap and so good.**

*Fig. 233 Prepared milfoil,
8 years old, followed by
1% gold chloride 287*



Chapter VII.

STINGING NETTLE PREPARATION.

- (1.) Introduction.
- (2.) Experiments :
 - (1.) The homoeopathic effect of the 1st-60th potencies of unprepared stinging nettle on the growth of wheat plants.
 - (2.) The same experiment with prepared stinging nettle.
- (3.) Tests with Capillary Dynamolysis :
 - (a.) Extract of stinging nettle.
 - (b.) Extract of unprepared stinging nettle followed by 1% gold chloride.
 - (c.) Extract of prepared stinging nettle followed by 1% gold chloride.
 - (d.) Extract of unprepared stinging nettle followed by 1% iron sulphate.
 - (e.) Extract of prepared stinging nettle followed by 1% iron sulphate.

(1.) Introduction

Dr. Steiner called the stinging nettle one of the greatest benefactors to plant growth. Its qualities are manifold. It has not only potassium and calcium radiation, but also a *specific iron radiation, which has just as much importance for nature, as the iron radiation has for our own blood.* **The stinging nettle regulates the iron household in nature.** For instance, if there are places where too much iron is in the soil, it is possible to free the soil of this superfluous iron by planting nettles here and there on places where we do not mind them growing. The nettles attract the iron and thus other plants get less.

This changes our whole outlook, if we know the real function of such a plant, which we often try to destroy, because it is sometimes disagreeable to get into "touch" with it. We really should be very grateful if we find nettles in the vicinity of our farms or gardens. No wonder that Rudolf Steiner suggests that this plant should be included in the preparations we add to our manure heaps. Nothing special has to be done with it. We simply collect as many as we can, let them fade slightly, and then bury the plants in the soil. Here we may use some peat moss to isolate the plants from immediate contact with the soil. The nettles must stay in the soil for a whole year; they must remain for one winter and one summer beneath the surface, and then they are ready for the compost heap.

It is good to recollect what we know about nettles, because sometimes we are inclined to forget the valuable qualities of a thing with which we are unreasonably annoyed because of its disagreeable aspects. The stinging nettle (*urtica dioica*) grows a yard or more high, has a creeping root and a ridged stem which is beset with little prickles or stings. These stings have a perforation at the point and a little bag at the base. In touching the plant, we press the sting, and it enters the skin. At the same time an acrid liquor from the bag, which produces a burning sensation, is pressed into the wound. The leaves are covered with these stings also. The flowers are greenish-white and insignificant. We find stinging nettles nearly everywhere, by roadsides and in hedges.

Culpeper tells us, that this plant belongs to the planet **Mars**. No wonder, because since the oldest times the planet Mars has been known to be connected with the metal iron. There is an old saying : " Mars is the God who makes the iron grow." We can say equally well that Mars is the God who makes the nettles grow, and we should not be wrong. The plant flowers in July and is used to combat many diseases. " It consumes the phlegmatic superfluities in the body of man, that the coldness and moisture of winter has left behind. The roots or leaves boiled, or the juice of either of them, or both, made in an electuary with honey and sugar, is a safe and sure medicine to open the passages of the lungs, which is the cause of wheezing and shortness of breath, and helps to expectorate phlegm, also to raise the imposthured pleuresy; it likewise helps the swellings of both the mouth and throat if they be gargled with it. The juice is effectual to settle the palate of the mouth to its place and heal the inflammations and soreness of the mouth and throat. If the decoction of the leaves be drunk in wine, it will provoke the courses, settle the suffocation and strangling of the mother, and all other diseases thereof; as also applied outwardly, with a little myrrh. The same, or the seed, provokes urine, and expels the gravel and stone. It kills the worms in children, eases pains in the sides, and dissolves the windiness in the spleen as also the body. The juice of the leaves taken two or three days together, stays bleeding at the mouth. The seed being drunk, is a remedy against the bites of mad dogs, the poisonous qualities of hemlock, henbane, nightshade, mandrake, or such herbs as stupefy the senses; as also the lethargy, especially if used outwardly, to rub the forehead or temples in that disease. The distilled water is effectual, though not so powerful, for the diseases aforementioned; as for outward wounds or sores to wash them, and to cleanse the skin from morpew, and other discolourings thereof. The seeds or leaves bruised, and put into the nostrils, stays the bleeding of them, and takes away the polypus. The juice of leaves or decoction of the roots, is good to wash either old, rotten, or stinking sores or fistulas and gangrenes, and such a fretting, eating, or corroding scars, manginess, and itch, in any part of the body, as also green wounds, by washing them therewith or applying the green herb bruised thereto. It eases the pains and dries or dissolves the defluctions. An ointment made of the juice, oil and a little wax, is good to rub cold and benumbed members. One handful of the leaves of green nettles and another of Wallwort, or Deanwort, bruised and applied simply themselves to the gout, sciatica, or joint aches in any part, hath been found an admirable help thereunto."

This we find in the herbal of Culpeper of about the sixteenth century.

In homoeopathic medicine of to-day the fresh herb is used as a remedy externally or internally for burns of the first degree, for itch in any part of the body (Urticaria), edematous swellings, diarrhoea, lessened urine secretion, and lack of milk after childbed. Nettle vinegar is used to enhance the growth of hair. The stalk contains a fibre suitable for making beautiful cloth. During the last war Germany tried to plant nettles especially for this purpose, and got about 13% of silky fibre from the nettle stalks. The dark green leaves are used for the production of chlorophyll.

Chemical analysis has found, amongst other substances, a rich content of potassium, calcium nitrate, silicic acid, formic acid, iron, tannic acid, mucus, wax, a red pigment—carotin (the same as in carrots).

We must also mention that the young plants are an excellent vegetable, similar to spinach; they may be used as salad, and as a good poultry food as well.

So we see that nettles are highly useful plants and should be more appreciated as a wonderful work of nature.

Many fairy tales are woven round the nettle. Who does not remember the beautiful story of the young princess who had to spin and weave garments from nettles for her thirteen brothers who had been changed into swans by a wicked witch? There is the story of the young girl who had to make her wedding dress, and the shroud of the bad overseer, to be released. The gypsies in Europe tell about little men "pcuvush," who live in the earth. They are very ugly, have hairy bodies and are invisible. They have three golden hairs at the tops of their heads and if they keep these uncovered, they are invisible. Whosoever can get a golden hair from these "pcuvush," can turn stones into gold. At the entrance of their subterranean dwelling-places is a huge heavy stone surrounded by nettles. Therefore the "pcuvush" people hold the nettle very dear. The gypsies call the nettle "Kasta pcuvushengre," "wood of the pcuvush." Some people may wonder why fairy tales are included in a scientific book about agriculture. But all these fairy tales have been written from out of a deep wisdom and insight into nature, only we must learn to understand them again.

(2.) Experiments with the Nettle Preparation

We gather the nettles in July when they begin to flower and take the whole plant without the roots, dig a hole, and press the herbs tightly into the soil. We need nothing else for this preparation, no special animal organ is necessary, only the forces which stream through the soil during winter and summer.

It is good to take young shoots which are not yet too woody, and the next year we get the composted nettle ready for the manure, and also for our experiments. Some plants we have dried and kept in glass jars in the laboratory for comparison. We start the usual test for the homoeopathic influence on wheat plants, using 1 gram of the herb in 10 c.c. of lukewarm rainwater, and then potentize to the 60th potency.

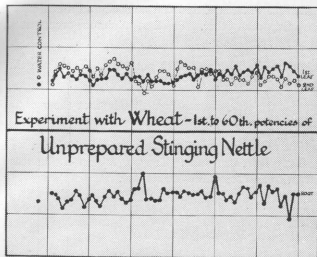


Fig. 234

Wheat plants grown under the influence of 1st-60th potencies of unprepared stinging nettle

The first maximum appears at the 16th potency, the second at the 32nd. The minimum at the 23rd potency, is a very intensive one, because the growth of the second leaf has dropped below the level of the first leaf. This phenomenon always means a strong effect. Then the second leaf rises again to the second maximum and drops once more to the second minimum at the 36th potency.

The roots have two minima at the 23rd and 40th potencies; first maximum is at the 4th and second at the 58th potency.

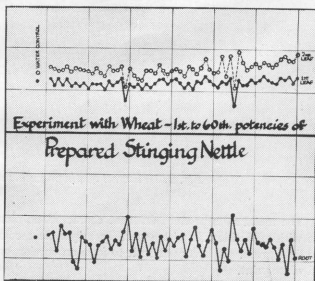


Fig. 235

Wheat plants grown under the influence of 1st-60th potencies of prepared stinging nettle

The graph shows a considerable difference. It is harmonized and much clearer. First and second leaf never overlap each other. The first minimum occurs at the 19th, the second at the 45th potency. The maximum is at the 46th.

The roots have the minima at the 20th and 45th potencies. There are three maxima, at the 8th, 42nd and 58th potencies.

Compared with the unprepared nettle, we see immediately that the roots are considerably improved with the prepared herb.

The weight shows the effect of the preparation still more convincingly. The unprepared nettle was exceedingly light in results. The prepared nettle increased the weight of the wheat plant twice and sometimes even more.

(3.) Capillary Dynamolytical Test

The extracts of the fresh and the prepared herbs are light green and of course there is not much to be seen in the picture of the juice alone. They both produce a thin light green border line,

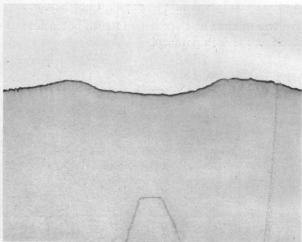


Fig. 236 Extract of stinging nettle alone

The metal salts produce different characteristic pictures. The most beautiful was with gold chloride, with especially bright clear colours : yellow, light purple and light green. It is very difficult to form an opinion by looking only at the black and white print.

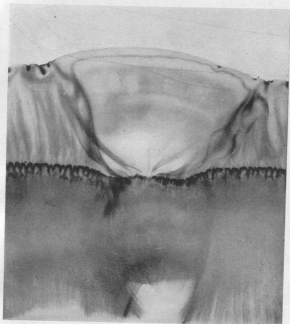


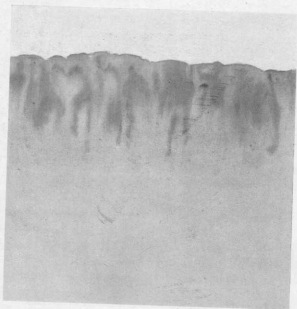
Fig. 237

*Extract of stinging nettle (un-
prepared) followed by 1%
gold chloride*

The experiment with iron sulphate changes the picture to a vivid moss green shade and from the top downward characteristic forms appear, but they are not quite clear.

Fig. 238

*Extract of stinging nettle (un-
prepared) followed by 1%
iron sulphate*



The experiment with prepared nettle and gold chloride shows a certain difference. The original looked much more alive. For an inexperienced eye it may be that the unprepared nettle seems even more beautiful. But it is not only a question of beauty, we must learn to discriminate between mere beauty and life-forces. The pictures reveal a stronger vitalizing force in the prepared nettle.

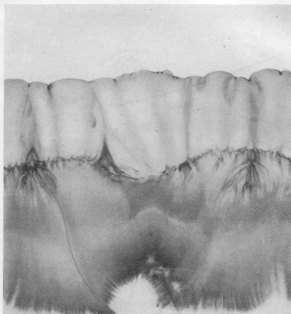
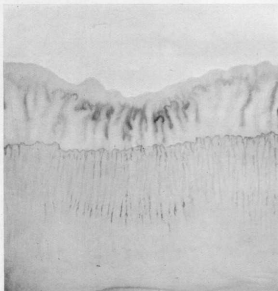


Fig. 239 Extract of stinging nettle (prepared) followed by 1% gold chloride

The greatest surprise is the experiment with the prepared nettle and iron sulphate.



*Fig. 240
Extract of stinging nettle (prepared) followed by 1% iron sulphate*

That is a great surprise. The forms are very delicate, compared with those from the unprepared nettle, but they are perfectly clear. The colour has the same moss green shade. From the border line formed by the nettle extract (about two-thirds of the picture) we notice a strong radiation downwards. With the magnifying-glass we see that the structure is divided into many tiny branches, like roots growing in the soil. The iron sulphate passing through the nettle extract leaves behind this marvellous radiating structure. Is it not a real picture of the action Rudolf Steiner describes as characteristic of the nettle plant in nature? The nettle regulates the iron household, collecting the superfluous iron in the soil, so that other plants may benefit by its regulating activity.

The method of Capillary Dynamolysis is very subtle, and if we understand how to use it, we have a new scientific method which allows us to penetrate deeply into the interplay of the hidden forces in the mineral, plant, and animal kingdoms.

The nettle preparation, which has concentrated in itself the quality which the natural herb possesses, is introduced in a small quantity into the manure heap. It makes the manure sensitive and is especially helpful in ensuring that the nitrogen content of the heap is kept intact.

Chapter VIII.

VALERIAN PREPARATION.

- (1.) Introduction.
- (2.) Experiments :
 - (1.) The homoeopathic effect of Valerian on wheat grown under the influence of the 1st-60th potencies.
 - (2.) Weight of the wheat plants.
- (3.) Tests with Capillary Dynamolysis :
 - (a.) Fresh extract of Valerian flowers with rainwater, followed by 1% silver nitrate. Experiment carried out in 1939 in Holland.
 - (b.) Similar experiment carried out with English Valerian in England.
 - (c.) Dutch Valerian followed by 1% gold chloride.
 - (d.) Dutch Valerian followed by 2% copper sulphate.
 - (e.) Dutch Valerian followed by 1% tin chloride.

(1.) Introduction

Valeriana officinalis can be found growing in many different places. We find it where the ground is marshy, near the edges of ponds, or on the borders of woods, between bushes where the sunbeams do not penetrate directly to the plants. In contrast to this, we also find valerian growing in dry, stony places, with some varieties in mountain regions. It is a perennial plant. The root is about as thick as a finger, is brown, and spreads itself laterally with many threads on each side. The leaves are very divided, dented on the edges, some winged to the middle rib. The stalk rises a yard or more and branches at the top with many small white and purplish coloured flowers.

Culpeper tells us that this plant is under the government of **Mercury**, and is useful in malignant fevers and pestilential distempers. It helps nervous complaints, headaches, trembling, palpitations of the heart, vapours ; it is alexipharmic, sudorific and cephalic. It is good in hysterical cases and epilepsies.

Usually the root is used as a remedy. The fresh root has not much scent, but the dried one has a very characteristic perfume. In reality we find this scent in the whole plant ; the flower gives out a perfume as also do the green leaves if we rub them between our fingers. That is the characteristic feature of valerian—the whole plant is permeated with a strange odour. Some think that the name “ valerian ” is derived from the Latin “ valere—to be of value, strong, to feel well,” because of the enormous therapeutic qualities of the plant. In England it is also called “ all heal.” In the Middle Ages people used it as a protection against evil spirits, witches and demons. Even nowadays we may find a bunch of dried valerian and other

flowers outside the door of old country houses, to protect the inmates from evil spirits. It was also the custom to hang a bunch of these dried flowers in the middle of the living-room. If anybody entered the room with an evil intention, the bunch began to grow restless, it moved and the farmer knew that the visitor wanted to do him harm. These bunches consisted of several kinds of flowers, but they always had some valerian in them.

Chemical analysis finds many acids in the valerian, namely the valerian acid, isovalerian acid, acetic acid, formic acid, terpineol, alcohol ($C_{51}H_{26}O$), alcaloids (chatinin and valerin), mucus, starch, resin, some tannic acids. We know so much about the different substances in this plant, and yet we are told "that until now, it is not quite clear which is the effective principle in valerian." The more details we find, the less we know of the active force.

Rudolf Steiner suggests adding valerian to the compost or manure heap because this plant helps it to find the right relation to the *phosphorous* substances. That is a very important statement. Of course it does not mean that we find phosphorus, as such, in the plant. The chemical analysis for valerian does not indicate the presence of phosphorus. Also Rudolf Steiner only said that valerian helps the manure to find the right relation to phosphorous substances. In other words, the plants gain the faculty of benefitting in the right way from the phosphoric substances in their surroundings. Everybody knows that the green colour in foliage, chlorophyll, can only be created by the plants, if there is **iron** in the neighbourhood. We do not find iron in every green leaf as a material substance, but if the soil were without iron, the leaves could not become green. The iron must be outside the plant organism, but it must be there; or we may say the amount of iron which the plant does take in, is in such a high dilution, that it escapes chemical analysis. The iron **radiation** acts in the leaves, but the iron material is not present in a measurable amount. Therefore it may well be possible, that the "right relation" to phosphorus can be established with the help of a special plant, which can attract those forces from the surroundings, even though we do not find phosphorus in a large amount. We need only the **force of phosphorus, not the substance.**

Valerian is the only vegetable addition to our compost heap which has not to be specially prepared. We use the **flowers** for this purpose. After putting them into lukewarm rainwater we squeeze them out, or better still, we put the flowers in a glass bottle of rainwater, keep it in the sunshine for several days (well stoppered, so that no odour escapes) then we squeeze the juice from the flowers. This concentrated tincture can be kept a long time. When the compost heap is finished (see Chapter IX) and covered with soil, and all the other preparations have been inserted, we sprinkle valerian in a high dilution over the heap. The right degree of dilution is the *7th* or *8th potency*, according to our experiments.

(2.) Experiments with Valerian

To find the right dilution we made our usual series of 60 potencies with wheat plants and obtained the following result :

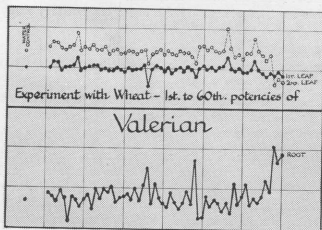


Fig. 241

Wheat grown under the influence of 1st-60th potencies of valerian

This is a very clear graph, which indicates as first maximum the 8th potency for the first and second leaf, and the 6th potency for the roots. **That is the potency we need for the treatment of the compost or manure heap.**

Then the first minimum, equally clear for the first and second leaf and root, happens at the 26th potency, the second minimum which is stronger for the root growth than for the leaves happens at the 38th potency.

The second maximum for the roots is the 39th and 40th potencies ; for the leaves the 46th; and a smaller one at the 53rd potency.

The third minimum for the leaves and roots is the 58th potency.

Equally interesting is the graph we get for the weight :

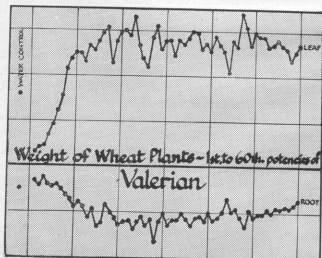


Fig. 242

Weight of Wheat plants grown under the influence of 1st-60th potencies of valerian

It is amazing how **heavy** the plants are relatively, if we compare them with the weight of wheat plants which have not been treated with valerian. We find a maximum weight at the 23rd potency and the 47th potency. The first minimum is at the 18th the second at the 26th and the third at the 44th potencies. The roots have two minima at the 17th and 44th potencies. The maximum appears at the 28th potency. We find here the same phenomenon that we found after the treatment with milfoil prepared in the stag's bladder, that the higher potencies help the plant to put on weight. **This cannot be explained as a material influence.**

(3.) Tests with Capillary Dynamolysis

We also studied the formative forces hidden in the watery extract of the flowers. The fresh extract has an immense power to form, with the help of silver nitrate and also with other metal salts like gold chloride, copper sulphate, iron sulphate, etc. We reproduce a few of these experiments.

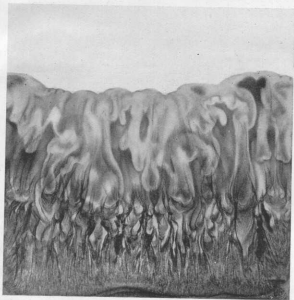


Fig. 243 Extract of valerian flowers with rainwater followed by 1% silver nitrate

It is exciting to watch these pictures grow. Half an hour after the silver solution has been added, many forms are already in process of forming. It is scarcely credible that out of the slightly yellow filter paper, impregnated with the juice of valerian, the silver nitrate makes those beautiful forms emerge. They are of vivid light and dark brown colours. This experiment has been carried out in Holland with valerian collected and extracted in Holland on the experimental farm of Mrs. Menten.

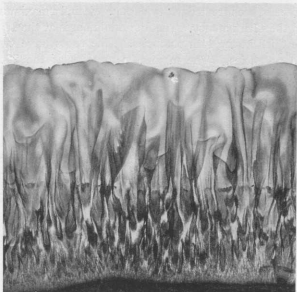


Fig. 244

*Extract of valerian flowers
with rainwater followed by
1% silver nitrate*

The experiment shown in Fig. 244 is part of a series carried out in England. The valerian was collected in England. If we compare these two experiments we come to the conclusion that the Dutch valerian was more effective.

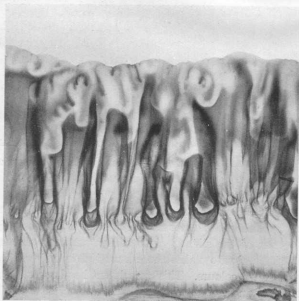
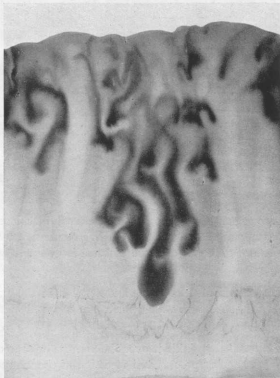


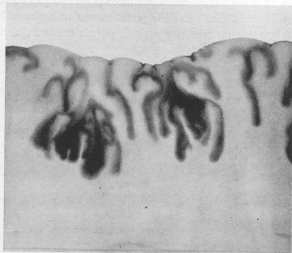
Fig. 245

*Extract of valerian flowers
with rainwater followed by
1% gold chloride
(Dutch)*

Also with gold chloride the valerian produces powerful forms. Not every plant can do this. The colours at the top of the picture are a thin purple border line, then light green and yellow, surrounded by a dark purple contour, and at the bottom bluish purple.



*Fig. 246 Extract of valerian flowers with rainwater
followed by 2% copper sulphate*



*Fig. 247 Extract of valerian flowers
with rainwater followed by 1% tin
chloride*

This too, is a rare event that such powerful forms can be created by plant juice, together with copper sulphate, or tin chloride. We regret that we cannot produce the whole series, because each one of these pictures is different and interesting to study.

It is quite obvious from all these experiments, that in the extract of valerian we have a very powerful substance which, for a plant, has an unusual capacity of form production.

If we dilute valerian and sprinkle it over the manure or compost heap we have a powerful aid in the vitalizing process and digestion of the manure.

The Capillary Dynamolysis reveals part of the forces hidden in valerian. We find another part if we keep an extract for a longer period. We had some huge glass jars stored on top of a cupboard in our laboratory at Stuttgart. The glass stoppers fitted tightly into the jars. After some time we noticed that the juice was working, and there was a noticeable development of gas. One day when we entered the room there were glass splinters and valerian scattered everywhere. One huge jar had burst into thousands of pieces. Such an immense force can be produced by valerian in its fermentation. We were able to rescue the rest of the jars by lifting the stoppers for a little while. Then the fermentation died down again. Strange to say, a year later, it happened again. We were so sure that nothing would happen—that we had to undergo the same experience and paid for it with another burst

jar, and two others threw out their stoppers and were partly cracked. Again the process died down. The third year the juice again began to work and develop gas. This time we were sufficiently warned and lifted the stoppers in time.

The second time it happened during the night, and we were still working in the room. It was like a real explosion and one of our collaborators, who worked two storeys below heard it and came up, to see what had happened. This explosive power is hidden in valerian.

We had kept the juice all this time because we wanted to find out, how long it may be stored for use. In 1939 we compared fresh juice here in England, and some extract which was only one year old, with our ten-year-old preparation. The latter was still effective. Of course there is no actual need to keep it such a long time. It is best to use the fresh extract.

Some practical hints on how to make the 8th potency :

We collect as many flowers as we can find, put them in a jar and add rainwater. We place this jar somewhere in the sun, and put a lid or stopper on it, so that the perfume does not evaporate into the air. After a few days we notice that the water has become brown. We press the liquid from the plants as much as possible. We must have a dark brown and strong-smelling extract. We take one part of it and add 9 parts of water (for instance 1 ounce extract and 9 ounces water). It is best to use rainwater. We fill a clean bottle with this mixture and shake it vigorously for about five minutes. Then we have our 1st potency. Now we need seven more bottles, and we repeat this process seven more times, always taking 1 part of the finished potency and adding 9 parts of fresh rainwater, shaking for five minutes. It is best to have eight bottles and to put a label on each, indicating the potency. The last bottle can be used for sprinkling over the compost heap. If we have two or more compost heaps we use our other bottles. From the 7th potency we can make nine more bottles of the 8th potency, always using one part of the 7th potency, adding 9 parts of fresh rainwater. Should it happen that we have used up the 7th potency and still want to sprinkle more manure heaps, then we use the 6th potency. From this bottle we first make one fresh bottle of the 7th potency, and then we can go on making 9 bottles of the 8th potency. It is a very cheap and a very economical way of treating the manure ; it is much more economical than the artificial fertilizers and is a healthy way too. It does not even take much time. To make the first 8 potencies we need about one hour, if we shake each potency five minutes.

Chapter IX.

THE TREATMENT OF MANURE AND COMPOST.

- (1.) Introduction.
- (2.) Experiments with manure treated according to Dr. Steiner's suggestions :
 - (1.) Extract from a **manure heap** (Holland) after two and a half months preparation.
 - (2.) Capillary dynamolytical test of the same extract followed by 1% gold chloride.
 - (3.) Extract from a **compost heap** (Holland) after only 12 days preparation.
 - (4.) Capillary dynamolytical test of the same extract followed by 1% gold chloride.

Experiments with **liquid manure** :

- (5.) Prepared sewage (Holland).
- (6.) Capillary dynamolytical test with the same substance followed by 1% gold chloride.
- (7.) Similar experiment.
- (8.) Prepared liquid manure from various organic refuse followed by 1% gold chloride.
- (9.) Prepared liquid manure from various organic refuse followed by 1% silver nitrate.

Treatment of **compost heaps** :

- (10.) Extract of prepared compost heap (Holland) followed by 1% gold chloride.
- (11.) Extract of prepared compost heap (England) followed by 1% gold chloride.

(1.) Introduction

We have mentioned already in previous chapters, that the making of a good manure, or compost heap, is a great art. What we want in agriculture is **life** in the soil for the plants, that is to say **humus**. It takes a long time for manure to rot and become humus, and very often during this time many valuable substances are lost ; some evaporate into the air, some are washed away by the rain, some are bleached out by the sun. These losses can easily be prevented by covering the manure heap with soil. If we start a new heap, we first dig out some of the soil, about 6 to 8 inches, and keep the soil near by to cover the heap with it later on. It is good to have the heap in close contact with the soil ; it should be taken into the inner breathing process of the earth, and this contact is enhanced by digging out a few inches, so that the heap reaches below the surface of the soil. The heap should be firmly trodden down ; and always covered with some suitable material, until it is high enough to cover with the soil that was dug out at the beginning. The thickness of the cover is determined by the quality of the soil. A very heavy soil (clay) has to be put on in a thin layer. The manure heap has to breathe, and the covering layer should not hinder this process. Fig. 248 shows the finished, well-covered manure heap.

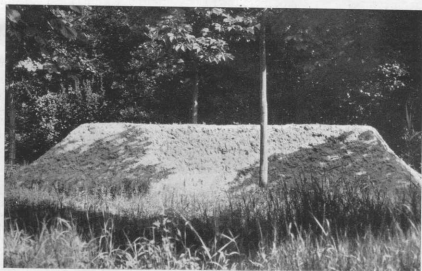


Fig. 248 Finished and covered manure heap ready to be prepared

The described preparations have to be inserted into it :

Camomile=C

Oak bark=O

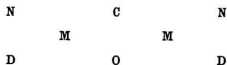
Dandelion=D

Stinging nettle=N

Milfoil=M

We make five holes with a wooden stick, one at each corner and one in the middle of the heap. The preparation should be inserted in them at least 10 inches deep. It is best to have the milfoil preparation in the middle and the other four preparations in the four corners.

If the compost heap is longer, the following arrangement can be made :



This allows an equal distribution of the radiating forces inside the heap.

The manure must be closely in contact with the preparations, and so must be well covered again with the manure and the layer of earth on the top. After all this has been completed, the last preparation, **valerian** is added. As described in Chapter VII it is best to use the 8th potency of valerian, and sprinkle this over the heap. The potencies should be made with lukewarm rainwater.

These preparations begin to act and produce the right fermentation in the manure or compost heap. Not more than 1 or 2 grams of each of these preparations should be inserted. The manure is quickly transformed. Two to three months are sufficient to impregnate stable manure with the radiating energies of the preparations. The farmer can convince himself of their value by observing the blackish-brown substance into which the manure is changed, and which is rich in humus, and *micro-organisms, that thrive lustily in it ; and it seems that all the earthworms of the neighbourhood have chosen it for a rendezvous. Life streams out of the heap ; life is put back into the soil.* We need less of this manure for the enlivening of the soil than we need of a carelessly treated, badly rotted dung.

(2.) Experiments with manure treated according to Dr. Steiner's suggestions

We refer to Chapter I in which we demonstrated the difference between cow manure one year old and cow manure buried in the cow-horn during winter-time beneath the surface of the soil. Fig. 182 is representative for untreated manure. If we make a test with our capillary dynamolysis we get similar, more or less chaotic, dark purple pictures. Therefore, we always turn back to this typical picture for comparison. On the 22nd February, 1939, we inserted our own preparations into some manure heaps in Holland on the farm of Mrs. M., who had asked us for help in establishing a farm according to Rudolf Steiner's principles. On 11th May, 1939, after two and a half months, we made our capillary dynamolitical test with manure from this heap. We took samples from various parts of it. One gram of the manure was dissolved in 10 c.c. of warm rainwater and after two days' extraction a series of filter-paper pictures was made. The slightly yellow liquid did not rise very high, and produced a slightly yellow border line (Fig. 249).

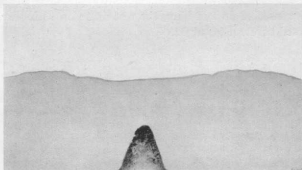


Fig. 249 Extract from a manure heap taken on the 11th May, 1939, prepared on the 22nd February, 1939

We add the different metal salt solutions, and choose as most characteristic the test with gold chloride, which has to be compared with the untreated manure picture shown in Fig. 182, Chapter I.

We believe that everybody, even without much experience in our method, will get a certain impression of the radiating forces which stream through this picture, and tell us that the preparation has been highly effective and has endowed the manure heap with a great vitalizing force.

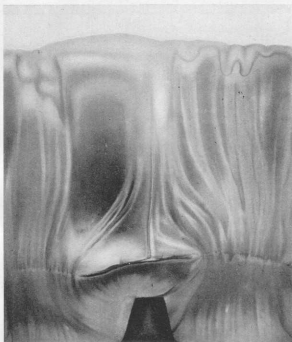
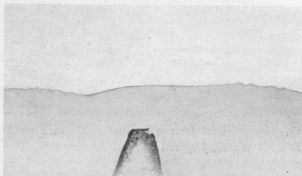
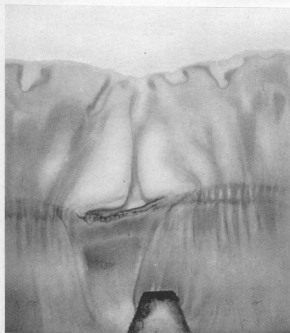


Fig. 250 Sample taken from the above-mentioned prepared manure heap, followed by 1% gold chloride

Another test was made with a very recently prepared manure heap. The preparations were inserted on 2nd May, the test made on 13th May, when the preparations had acted barely a fortnight.



*Fig. 251 Extract of the prepared heap
(2nd-13th May, 1939)*



*Fig. 252
Extract of the prepared heap
(2nd-13th May, 1939),
followed by 1% gold chloride*

The similarity is very striking, and without any doubt due to the inserted preparations.

One of the greatest wastes we find in agriculture, is the careless way in which liquid manure is treated. Many farmers just let it run away, and a marvellous help for farming and gardening is lost.

Liquid manure can also be treated with our preparations, and transformed into a first-class fertilizer which costs next to nothing. If a farmer has made appropriate arrangements for

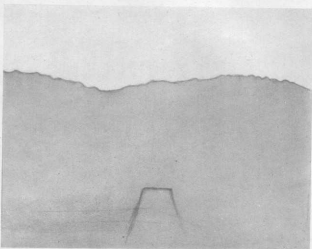


Fig. 253 Prepared sewage rising in filter paper

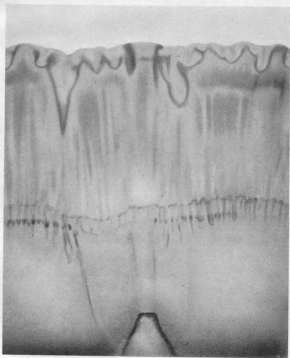


Fig. 254 Prepared sewage followed by 1% gold chloride

collecting the sewage, the preparation can be made as follows. Two pieces of wood are nailed together in the form of a cross, the preparations are placed in small muslin bags, weighted down with a small stone (of course not so heavy that the muslin bag breaks), the bags are fixed with a 20-inch long thread on the corners and the middle of the cross. The wooden cross, carrying the five preparations, floats on the surface, and radiates its forces into the sewage. We show some tests with sewage treated in the manner described.

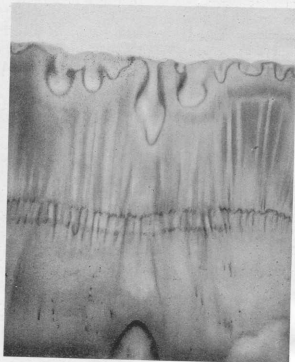


Fig. 255 Prepared sewage followed by 1% gold chloride

These tests reveal a good penetration of the sewage with the harmonizing and vitalizing activity of our preparations.

Another valuable help which the gardener could have, even on a small scale, is a wooden barrel, or several wooden barrels containing organic waste products. Poultry-keepers could use some of their poultry manure, pulverized egg shells, bone meal or horn meal and similar organic waste which can easily be obtained ; or perhaps some cow manure can be added. All these are mixed in the barrel which may be kept near the manure or compost heap. It would be still better to dig the barrel partly into the soil, and partly cover it up with soil (Fig. 256), fill it with rainwater, and cover it. Then five hooks are fixed in the lid and the preparations hung in muslin bags on these hooks, so that they are suspended about fifteen inches in the liquid. After two to three months a first-class fertilizer for the vegetable and flower garden is ready.

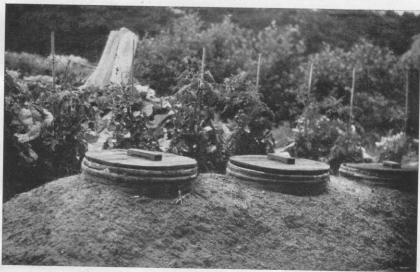


Fig. 256 Barrels partly dug into the soil containing various organic refuse

After two months we make the Capillary Dynamolitical Test with the following result :

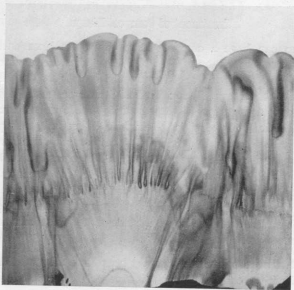


Fig. 257 Prepared liquid manure from various organic refuse, followed by 1% gold chloride



*Fig. 258 Prepared liquid manure from various organic refuse,
followed by 1% silver nitrate*

Treatment of Compost Heaps

Every garden can have a compost heap if we use lawn cuttings, vegetable refuse, kitchen refuse, and so on. We build it up like the manure heap, at first digging out some of the soil for covering up the heap later on. This differs only in one respect from the manure heap : Rudolf Steiner suggests having small layers of quicklime alternating between the layers of vegetable refuse, each layer trodden firmly down. The finished heap is covered with the soil, and prepared as the manure heap is. The process is quickened if between we add some good soil. Of course it takes longer for the compost to rot, and be transformed into a substance rich in humus, than is the case with stable manure. It depends entirely on the refuse we put into the compost heap as to how long it takes to ripen. It is best to turn the compost heap after half a year ; then of course the lime gets mixed with the vegetable refuse, and there are no separate layers. If necessary the preparations may be added once more.

We may put all weeds into the compost heap, but they should be in the inner part of it. In about a year the compost is ripe ; decomposition, with the help of the preparations, is complete. It smells beautifully, and again we find that it has a great attraction for the earthworms.

Experiment to test the quality of the Prepared Compost Heap

We use the method of Capillary Dynamolysis. At first we dissolve 1 gram of the compost taken from the middle of the heap, dissolve it in 10 c.c. rainwater, then let the liquid rise into the filter paper afterwards followed by 1% gold chloride.

Fig. 259

*Prepared compost heap
(1 year old) extract followed
by 1% gold chloride*

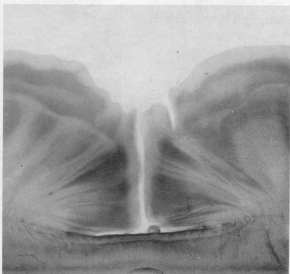
The test looks very similar to our prepared manure heap and is an excellent fertilizer for the garden.

Another test carried out with a compost heap prepared by Mrs. Howard Pease in the Old Mill House, Bray, Berks.

Fig. 260

*Prepared compost heap extract
followed by 1% gold chloride*

This method enables us to judge very quickly the value of any manure or compost heap, or any other fertilizer. We will give a few more examples. Some of them are very negative, but we learn to appreciate the positive things even more, if we observe the negative things too.



Chapter X.

Experiments with Peat-moss, Hop Manure, Dried Blood, Artificial Fertilizer "G," Fertilizer produced with the help of a specific bacterium

- (1.) Capillary dynamolytical test with peat-moss.
- (2.) Similar experiment with hop manure.
- (3.) Similar experiment with dried blood.
- (4.) Similar experiment with artificial fertilizer "G."
- (5.) Similar experiment with fertilizer produced with the help of bacteria.
- (6.) Homoeopathic effect of the artificial fertilizer "G" on the growth of wheat plants grown under the influence of the 1st—60th potencies.
- (7.) The same experiment carried out with the fertilizer produced with the help of a specific bacterium.

For instance, we may ask whether peat-moss is a good fertilizer?

Fig. 261

Capillary Dynamolytical test of peat-moss (1% extract), followed by 1% gold chloride

The test says: "No." There is scarcely any life left in peat-moss. We ask again: is Hop Manure good as a fertilizer?



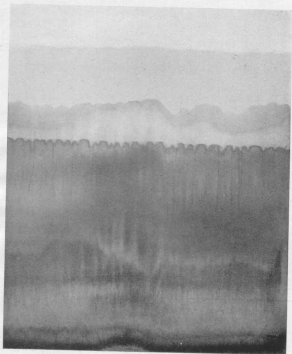


Fig. 262

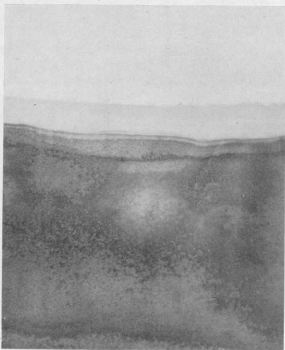
*Capillary Dynamolytical test with hop manure
followed by 1% gold chloride*

The test reveals that hop manure is better than peat-moss, but there is not enough life in it to enable it to act as a really vitalizing force for the soil.

What about "dried blood"?

Fig. 263

*Capillary Dynamolytical test
with "dried blood" followed
by 1% gold chloride*



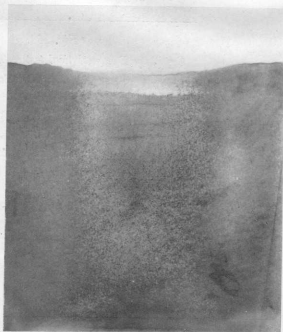
The test says definitely "No." There is no life in this "fertilizer"; the gold has become brown and dirty, and looks "burnt" to death.

There is another well-known preparation which is much advertised for small-holders, and many people buy it. We will call it "G." There is a long description on the package promising all the good things possible for the vegetable garden.

We try it :

Fig. 264

*Artificial fertilizer "G"
1% extract followed by 1%
gold chloride*



We need only compare such an experiment with the prepared cow manure, or even the unprepared cow manure, to see immediately that this "fertilizer" cannot be of value to the soil.

Once we had a long talk with some English scientists, who were convinced that they had found the solution to the fertilizer problem. We were told of a marvellous method for converting every kind of town rubbish, really everything, organic or inorganic, into a good fertilizer. The process is quick, and is done by a specific bacterium which produces heat. We were told so much—the rest was a secret. The preparation was cheap; it could be used in large quantities and the practical results were good. We asked for a sample and received it immediately. The substance looked grey, and smelt like ash. It was a fine dust-like powder, a perfectly dead material to the touch—not to be compared with real plant compost. Still the scientists assured me that it was a good compost. We tried with Capillary Dynamolysis :

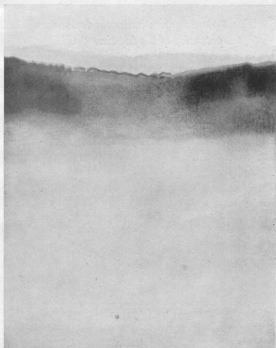


Fig. 265 Fertilizer produced with the help of a specific bacterium, followed by 1% gold chloride

There is no need to say much about this fertilizer either. It is dead and cannot make the soil alive. So what is the use of it? Even if it is cheap? However, we do not want to be unfair to these artificial fertilizers, so we also make the experiments with potentizing from the 1st to the 60th potencies.

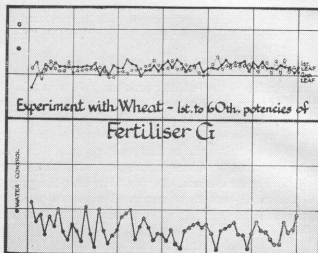


Fig. 266 Wheat plants grown under the influence of the 1st-60th potencies of the fertilizer " G "

The leaves are very tiny. The experiment was carried out in the month of July, and the wheat plants should at least be twice as long. It is evident, that the "fertilizer" has retarded the growth of the leaves. Furthermore the first and second leaf are so entangled that we can scarcely distinguish the two graphs.

The root development is much better, but it is very difficult to decide about maximum and minimum growth.

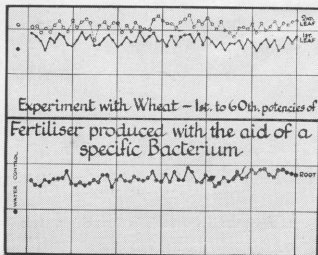


Fig. 267 Wheat plants grown under the influence of 1st-60th potencies of the compost gained with the help of bacteria

There it is the opposite way round. The leaves are quite good, and the roots are small. First and second leaves are easily distinguishable. But here also it is difficult to decide about a maximum or minimum growth.

How does a soil change if for some years it is subjected to the treatment described in the previous chapters?

Chapter XI.

Capillary Dynamolitical Tests of untreated and treated soil

- (1.) Capillary dynamolitical test of soil.
- (2.) Capillary dynamolitical test of soil having been treated for three years according to Rudolf Steiner's suggestions.

Before starting the treatment we examined soil taken from various places by means of Capillary Dynamolysis. The best result we obtained is shown in Fig. 268.

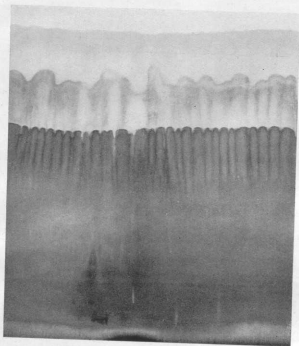


Fig. 268 Soil test before the treatment followed by 1% gold chloride

Three years later we examined again and found the following results :

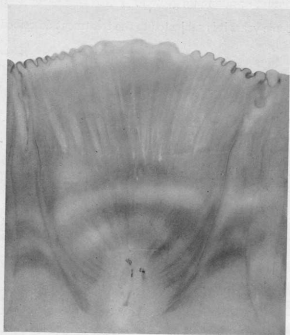


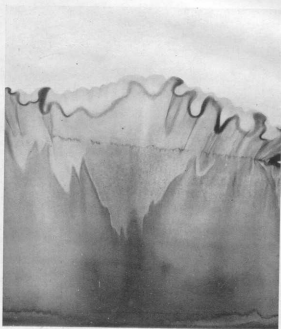
Fig. 269

Soil test with 1% gold chloride after three years' treatment according to Rudolf Steiner's suggestions

Fig. 270

Soil test with 1% silver nitrate after three years' treatment according to Rudolf Steiner's suggestions

The soil has undergone a change which convinced us of the great advantage this method produces, if faithfully applied in all details.



Chapter XII.

BRIEF RESUME OF THE PREPARATIONS SUGGESTED BY RUDOLF STEINER FOR A RENEWAL OF AGRICULTURE.

Silica

- (1.) Pure Silica Sand (pulverized rock crystal)—kept in cow-horn, during summer buried in the soil. Later on applied in homoeopathic doses as a spray, helps a soil lacking in silica (see Part II, Chapter VIII).
- (2.) Dandelion—treated as described in Part III, Chapter IV, has the faculty of regulating the relation between silicic acid and potassium in the plant organism. Used in homoeopathic doses as addition to manure or compost heaps.
- (3.) Equisetum—a plant containing in its life process an enormous amount of silica (see Part II, Chapter IX) used as remedy for plant diseases, in cases where plants are attacked by different insect pests due to a wrong composition of the soil. See details in the Chapter : Equisetum arvense as a remedy for different plant diseases.

Calcium

- (1.) Quicklime—mixed into compost heaps in small quantities (see Part III, Chapter IX).
- (2.) Used in homoeopathic doses as a spray on soil lacking calcium (see Part II, Chapter XII).
- (3.) Oak bark—treated as described in Part III, Chapter III, acts in a prophylactic way against plant diseases. It is used in homoeopathic doses as addition to compost and manure heaps.

Sulphur

- (1.) Camomile—(see Part III, Chapter V). The camomile plant has a certain relation to the sulphur process which enables it to regulate the consumption of calcium. Added in homoeopathic doses to the manure or compost heap.
- (2.) Milfoil—(see Part III, Chapter VI). This plant also is related to the sulphur process. We even find some traces of sulphur in the roots. Milfoil has the capacity of regulating the potassium metabolism in plant life with the help of the sulphur process.

Phosphorus

Valerian—(see Part III, Chapter VIII) helps the manure to find the right relation to the phosphorous substances in the surroundings. Used in homoeopathic doses as addition to the manure and compost heap.

Iron

Stinging nettle—(see Part III, Chapter VII). This plant regulates the iron household in Nature. If the soil contains too much iron we should plant stinging nettles. They attract the superfluous iron. Added in homoeopathic doses to manure and compost heaps. Helps to regulate the nitrogen content.

Concentrated Cow Manure

Cow Manure—see Chapter I, used as a spray in homoeopathic doses to enliven the soil.

Chapter XIII—Weeds

It is difficult to define what a weed really is. In some books we find the following definition : A weed is a plant that grows in a place where we do not like it to grow.

That is a very simple definition—but not a good one. Very much the contrary. Many plants which we consider weeds are excellent remedies. A large proportion of the preparations we add to the compost heaps are so called “weeds,” such as dandelion, nettle, horsetail, milfoil. At the same time they are very powerful remedies. We must be very careful in using this expression. On the other hand it is perfectly true that we do not like the dandelion growing everywhere in our gardens. The main question is : how can we restrict the growth of dandelion, or nettle, or milfoil, or whatever plant it may be, that has the tendency to grow too abundantly for our needs?

We must bring something into the soil that the weeds do not like. It is very simple but effective advice that Rudolf Steiner gives us. The power to reproduce new plants is concentrated in the seeds. **We burn the seeds** of those weeds which we want to restrict in their growth, collect the ash, and scatter it over the field. That is again an action of smallest entities. We do not need a great quantity of seeds. The ash radiates out over a large area, counteracting the reproductive force the seeds contain.

We carried out experiments, for instance, with seeds of **thistles**. After two years we still found thistles growing on the spot where we had used the preparation of burnt thistle seeds. The plants looked quite healthy, but when the seeds began to ripen, we noticed that they began to deteriorate. In the third year the thistles were very scarce, and after four years' treatment they disappeared completely from the treated area.

Nearly all our experiments with weeds have shown us first the phenomenon of seed-deterioration, and then the plant no longer grew in the treated district. But the whole process takes about four years, and each year the treatment has to be repeated.

This again is a very economical and healthy way of disposing of unwanted plants. We do not need chemicals which damage the soil or poisons to kill the weeds. The most natural thing is done : **we combat the plant with the counter force of the same plant.**

Some practical hints for making these preparations :

The seeds of all the different weeds we want to get rid of are first collected. Of course they must be quite ripe. Then they are burnt in the open on a small heap of wood, the remaining ashes are collected (wood ash plus burnt seeds) mixed in a mortar with a pestle or some other suitable tool, and then the ash is scattered over the field.

Or we can burn the seeds in a frying-pan and get only the ash of the seeds without the burnt wood. In order to distribute the ash over the required area, we take some potting sand, or soil from the field, and rub it together with the burnt seeds very carefully, as was described in the chapter on "Smallest Entities," for remedies which are insoluble in water and are potentized with the help of a neutral medium like lactic sugar. So we potentize the burnt seeds with the soil, and scatter this potency over the field in which the weeds are growing. Every farmer and gardener can easily make these preparations. They do not cost a single penny, and definitely help him to get rid of unwanted plants.

Chapter XIV.

Destruction of Insects, Field Mice and Slugs

How to abolish Insects

To dispose of insects, something similar is done as for weeds. We collect the insects, for instance rose beetles (but this applies to all insects) and burn the whole insect during a certain constellation. The insect world has to be studied in connection with the course of the Sun through the zodiac. The sun acts differently if it stands in Leo, or Virgo, or Libra; different forces stream down upon earth and enter plant and animal life. We must use the right forces of the sun when burning the insects (Sun in Taurus) so that the ash counteracts the life process of the special insect we want to destroy.

The Moon and Water are a unity—as we explained in the chapter dealing with the influence of the moon on plant growth. We use their forces to help plant growth. **Fire destroys fertility.** The radiating force of the burnt seeds makes it undesirable for the plants to grow in that place; the ash of the burnt insect radiates into the surrounding soil, and the insect does not like to live in an area whence there streams out the counter force to its own life force, its power of reproduction.

How to get rid of the Fieldmouse

It is very annoying for the farmer if part of his crop is destroyed by mice. Many things have been tried for killing mice, many poisons have been used, yet all these experiments are unsuccessful. The mice come again and again.

Dr. Steiner gives strange advice. We have to look for a certain constellation of the planet **Venus**, collect the skins of mice during this time, and burn them. If we scatter these ashes over the field the mice will disappear. It is not necessary to burn the whole mouse, we only need burn the skin.

How can we verify such assertions? They seem so very strange to us. Our first experiment carried out in 1926 will be described. We began by breeding a large number of white mice in order to carry out the necessary experiment during the constellation of Venus. The mice were kept in glass cages covered with wire mesh in a separate room, well equipped for this purpose. Each cage contained a male and a female mouse.

The day of the constellation came, the exact hour for the experiment was fixed for four o'clock in the afternoon. We examined the mice every other hour, and found everything in complete order. At two o'clock in the afternoon we examined them for the last time, when feeding them. Some minutes before four o'clock we entered the room again and had a real shock. In each of the cages one mouse was killed. **The female Mouse had killed the male.** In all the cages there was the same ghastly spectacle. The killing was done so, that the female mouse had bitten through the throat of the male, then opened the skull and begun to eat the brain. Some mice must have started earlier or worked more quickly, because we found different stages of this terrible process. In a few cages the female mouse was sitting quietly beside the victim, looking innocent, as if everything was all right. Some mice had apparently first eaten the brain, and then started to eat the other inner organs, beginning with the lungs and working downwards to liver and kidneys. Some stopped after having eaten the brain—they had bitten off the four paws and placed them symmetrically in a square in the sawdust.

We shall never forget this spectacle. Probably we had not fixed the right moment for our experiment. The planet Venus came to the highest effectiveness earlier than we presumed and the female mice acted under this influence. No other explanation was possible. The constellation of Venus had driven the female mice to kill their mates in this extraordinary way.

Rudolf Steiner really knew about all these forces, how they work in the plants, in the animals and in the human organism. All his indications are correct. If we burn the seeds of the plants we interfere with the forces of reproduction in plant life. If we burn the whole insect, we interfere with the reproduction in animal life, but then we must take the sun into consideration. The sun must stand at a certain place in the zodiac. If we burn the skins of higher animals, we again interfere with the force of reproduction—then we must see that the planet Venus stands in a certain constellation. That we are interfering with the forces of reproduction is quite obvious from the fact that the female mouse killed the male.

We may recall here the fact that a similar phenomenon has been observed with certain spiders. Immediately after the mating has taken place, the female spider kills the male and eats it.

Or the bees kill the males after the queen has been fructified.

The mice killed their mates when the planet Venus came into a certain constellation.

Such a knowledge is an immense weapon in the fight against different higher animals which do damage in agriculture. But it also places a great responsibility on those who use this knowledge.

Report of a similar Incident

About a year later we had a visit from a young farmer who had tried to get rid of his fieldmice according to Rudolf Steiner's suggestions. He kept seven mice in a cage on the field, and when the time came to make the preparation, he found

only one mouse left. It was a great pity that he did not observe whether the mouse which was left was male or female. We presume it was the female mouse who had killed and eaten the others, which must have been males.

The use of the mouse preparation is limited. The radius of action is fairly large, but if, for instance, a smallholder uses such a preparation, and he is surrounded by neighbours who do not use the same, he will never completely get rid of the mice. They will withdraw to the neighbour's land unless he also can be persuaded to use the remedy.

Slugs

If young leaves in vegetable gardens are eaten by slugs, we make them unpalatable for them by spraying the plants with an extract of the seeds of *Picea excelsa*.

Three grams of the seeds are crushed to a fine powder in a mortar, then we add slowly lukewarm water, stirring incessantly at first to a thick pulp, then to a thin pulp; we then put it into a bottle and add lukewarm rainwater until we have 1 litre=1,000 c.c. Shake the bottle vigorously for about five minutes and then place it in the sunshine. From time to time we shake again. This emulsion is sprayed over the plants and soon the slugs disappear.

Chapter XV.

Regeneration of Potatoes

It is a well-known fact that many plants are degenerating through modern methods of cultivation, and then diseases begin. For instance, such plants as potatoes often show signs of degeneration due to wrong manuring, maltreated soil, etc.

For the regeneration of potatoes Rudolf Steiner suggested cutting out carefully a single eye with a tiny amount of potato substance adherent to it. The new plant therefore does not get much nourishment from the degenerated mother plant. The next year this process is repeated. From the new potatoes grown out of the single eye, we again cut out a single eye and plant it. Thus we get good regenerated potatoes.

We have tried this experiment with the following result :

First Year :

First series : planted two days before Full Moon

Average weight for each row	21.0 lb.
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Average weight for each row, single eyes	...	9.5 lb.
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Second series : planted two days before New Moon

Average weight for each row	17.0 lb.
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Average weight for each row, single eyes	...	6.0 lb.
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The potatoes looked quite healthy which were grown from the single eyes, but they were much smaller than the other series.

Second Year :

First series : planted two days before Full Moon

Average weight for each row	...	...	...	24 lb.
Average weight for each row, single eyes	...	...	...	14 lb.
Cut from last year's single eyes	...	...	...	38 lb.

Second series : planted two days before New Moon

Average weight for each row	...	...	...	20.5 lb.
Average weight for each row, single eyes	...	...	...	8.0 lb.
Cut from last year's single eyes	...	...	...	26.0 lb.

The potatoes we harvested after the second treatment, that means potatoes raised again out of a single eye of a potato which had already been once treated in this way, had the normal big size, looked healthy, and tasted much better. So we strongly recommend regenerating potatoes by this simple method. Of course it would not be very useful to regenerate potatoes, if the whole wrong system of manuring with artificial fertilizers, is not also changed.

THE FORMATIVE FORCES OF VARIOUS SUGARS, HONEY AND SACCHARIN, STUDIED WITH CAPILLARY DYNAMOLYSIS.

Many years ago we started to study various sugars, to compare them with various kinds of honey. We do not intend to embark on a detailed discussion of these complicated problems and wish only to go far enough to make understandable very valuable advice which Dr. Steiner gives in regard to feeding bees with sugar.

We apply the term "carbohydrates" to a class of compounds which are either sugars, or can readily be converted into them by hydrolysis. They contain only **carbon** together with oxygen and hydrogen in the right proportion to form water. We discriminate between Monosaccharides (Glucose, Fructose); Disaccharides (cane sugar, maltose, lactose); polysaccharides (cellulose, starch).

Glucose, a very important sugar, occurs together with fructose in various fruits and kinds of honey. Glucose has been synthesised and is manufactured on a large scale for use in numerous industries as a substitute for cane sugar. The source of glucose is starch, either of potatoes, rice or maize, which is heated under pressure. Then 1% sulphuric acid is added, and later again chalk to neutralise the acid. Calcium sulphate is formed which can be filtered off. Still further on the glucose may be decolourised by charcoal, and concentrated in vacuum pans. It may be used in the form of the moist crystalline mass (*e.g.*, maize syrup) or it may be recrystallised. Glucose has a sweet taste, but less sweet than cane sugar.

Compounds of glucose with organic substances, the glucosides are found in plant tissues.

Fructose is found in fruit juices and honey. It can be made by hydrolysing **inulin**, a starch-like substance, by means of dilute acids. We find inulin, for instance in the tubers of dahlia or in the Jerusalem artichokes.

Cane sugar occurs chiefly in the sugar cane, an enormous grass with a massive stem in which tissue the sugary juice is stored. It grows only in tropical or semi-tropical climates. The cane is either sliced or crushed and the juice pressed out. The crushed cane is sprayed with water and again squeezed several times. The raw juice thus obtained, contains between 12% and 18% of sucrose and many impurities. Lime is added and the juice heated, then the impurities are filtered off and the juice evaporated in vacuum pans. The concentrated juice is allowed to crystallize. In this way the raw sugar is obtained from the sugar cane which has to undergo a further refining procedure. At first the sugar crystals which still have some molasses adhering to them, are rotated in centrifugal machines, then sprinkled with water, that most of the molasses are carried off with the water, without dissolving the crystals. Still the sugar is not yet white and has to be further cleaned in filtering through charcoal. The colourless syrup obtained

by this treatment has again to be evaporated in vacuum pans and is allowed to crystallise and dry by hot air. This is the product we know under the name of granulated or castor sugar.

Beet sugar is extracted from the sugar beet cultivated in all parts of Europe. The average sugar content of sugar beet is between 12% and 15%. To extract the sugar the beets are at first sliced and soaked in hot water. The sugar diffuses into the hot water together with dissolved mineral salts, some colloidal matter and other impurities. The next step is to concentrate the juice by boiling in vacuo. Finally the concentrated liquid cools down and crystallises. It is a thick mixture of sugar crystals and mother liquor. The sugar crystals are separated from the mother liquor by centrifugal machines and represent then the "raw sugar," which has to be refined to become white sugar, as described above for cane sugar.

Honey comes from the plant kingdom. The bees suck the nectar out of the plants and in absorbing it into their organism change the nectar into honey. There are mainly two sources to be considered, the nectaries of the flowers which give us the so-called blossom honey which varies again according to the flowers and countries. The other source is the honey dew exuded in form of a sweet, sticky substance from leaves, needles and branches of herbs, bushes and trees. Usually this type of honey is also called forest honey. The main sources for honey dew are *Picea excelsa*, *Abies alba*, larch (*laryx decidua*) maple (*acer*) oak (*quercus robur*) and lime (*tilia*).

The chemical analysis shows that honey contains about 18% of water, many soluble organic compounds of various sugars, (invert sugar, cane sugar, melezitose), traces of organic acids and nitrogenous compounds (lime, iron, manganese etc.). Further we find various ferments, partly derived from the plants themselves, but mostly coming from the glands of the bees, diastase and invertase. All these details can be found in the comprehensive book written by Prof. Dr. Enoch Zander, Director of the Bavarian Institute for bee-cultivation in Erlangen. It is a recent publication dedicated especially to the study of the various pollens and methods to determine scientifically the origin of various kinds of honeys. After dealing with the content of ferments, Professor Zander continues: "they make the honey to a living entity and can be traced by biological research methods." Furthermore, we find in honey various formed objects, the pollen, cells of yeast and bacteria. Have the bees collected honey dew, then various algae fungi and similar microscopic organisms can be found, which were living on the needles, leaves or stems of the plants from which the bees collected honey. Also certain impurities, soot, fibres from cloth, hairs from the bees can be found with a microscope.

Prof. Zander mentioned, that years ago there were still people who believed they could judge the quality of honey with their tongues or noses. It may be acknowledged that the test carried out with our senses may give some results, especially if the honey has characteristic qualities, but in most cases this method is insufficient and has to be abandoned. The chemical research also comes to

its limits due to the fact, that the chemical constituents of honey are practically the same all over the earth. Whether a honey has been collected in Germany or Chile cannot be found with the most exact analytical methods, dealing with the water, sugar, ash and other contents of the honey. Chemical research is completely useless for determining the origin of various kinds of honeys. It can only reveal falsifications with cane sugar, etc.

Then there came the time, continues Prof. Zander, when it was thought possible to judge honey according to its biological differences. The content of ferments and diastase of foreign and inland produces would differ considerably. But soon it was found that also this was not a reliable basis for judgment. At the end only the microscopical test seems left. With it we can find if the honey is derived from flowers, then the sediment contains chiefly pollen, or if it is derived from honey dew, then it contains mainly algae, fungi and other microscopic objects from the plant kingdom. The Pollen is a kind of geographical document showing from which district or country the honey comes, if it is clover, or heather, lime, or forest honey. The pollen even tells us if the honey comes from Europe or other foreign countries. To judge this an intimate knowledge of the pollen of various plants is necessary and therefore the book of Prof. Zander is dedicated entirely to the study of pollen.

Having considered these various sugars (glucose, fructose, cane sugar, beet sugar) and honey, we may perhaps also mention a well known substitute for sugar, **saccharin**. It has no nutritive value whatsoever, is exceedingly sweet (about 300 times as sweet as cane sugar) and is the imid of ortho- sulpho- benzoic acid. It is a purely chemical product, a white, crystalline powder, not easily soluble in cold water. Some countries prohibit its use as sugar substitute unless for medical reasons. Here, in England, it is freely used, especially now during the war for sweetening tea or coffee. Therefore we have included some experiments with saccharin in our present report.

We studied in the first place the plants themselves out of which sugar is extracted and compared the result gained by capillary dynamolysis with an experiment carried out at the same time under identical conditions with the manufactured product. Of course we can only give a small selection of experiments, but hope that it will be sufficient to make the reader understand the various most characteristic formative forces hidden in these substances. Nearly all the tests, published on the following pages with only a few exceptions, have been carried out with the help of gold chloride.

We start with an extract of sugar cane (Fig. 271) and compare it with unrefined cane sugar (brown crystals). (Fig. 272). As far as the formative forces are concerned, the fresh sugar cane is more lively, the colours are more vivid, the rising height considerably higher, compared with the cane sugar. Quite objectively judged, the cane sugar has lost some of the original formative forces in the manufacturing process.

The fresh extract of a sugar beet (Fig. 273) shows a very delicate but rich formative force, with light purple, green and yellow tinctures. The experiment with beet sugar (Fig. 274) looks much more rigid, hard, and has definitely lost a good deal of the original plant forces. The rising height is increased in the experiment with sugar beet. Since the tests are carried out at the same time under identical conditions, the differences in rising height are entirely due to the differences of the substances.

Maple Sugar (Fig. 275) shows a beautiful delicate structure especially in the lower part of the picture. It is more lively than the refined white beet sugar, even more lively than the un-refined cane sugar.

Golden Syrup (Fig. 276) is also very beautifully formed and coloured. The forms are characteristic and differ from all the previous ones. Fig. 277 is an experiment with another variety of golden syrup and shows the same characteristic forms.

Dried Figs (Fig. 278) have a very strong formative force hidden in them. The original was beautiful in coloration, light and darker purple shades intermingled with blue and greenish yellow. Much of the life process of the plant is still active in this extract.

Dates (Fig. 279) produce more delicate forms than figs, but also here we see a rich formative force moulding and shaping characteristically. The colours were light purple, light green and yellow.

The following experiments deal with various kinds of honey. We start with English Honey:—Gloucestershire (Fig. 280), Berkshire (Fig. 281), Yorkshire (Fig. 282), Otterburn Heather Honey (Fig. 283). These four examples show already how entirely different honey is from the previously studied substances. Its formative power is very strong and different for each variety. Let us turn back to the statement of Prof. Zander, that chemical research is useless for determining the origin of various kinds of honey because the chemical constituents of honey are practically the same all over the earth; biological methods too are insufficient, and still more the subjective judgment of our senses. May it not be possible that our method of capillary dynamolysis, dealing with the formative forces hidden in all the substances, could be of great value in this direction?

Fig. 284 is an example of **Swiss Honey** and Fig. 285 of **Tyrolean Honey**.

Fig. 286 comes from Greece and Fig. 287 is again an English produce blended with invert sugar. Here we see definitely a disturbance in the usually clear, bright forms of pure honey. The forms are unsharp, washed out, the colours dulled down.

Figs. 288 and 289 are two examples of South African honey, rich in radiating lively forms and beautiful in colour.

Figs. 290 and 291 are two examples of Californian honey and Fig. 292 an example of **New Zealand** honey followed by Gold Chloride, (Fig. 293) the same

honey followed by Silver nitrate. Gold chloride and silver nitrate are able to reveal the formative forces of honey; but the experiments with silver darken so quickly, that it is very difficult to get a good photograph in time. Fig. 294 and Fig. 295 give another example of New Zealand honey followed by gold chloride and silver nitrate respectively.

These few examples have to suffice, but we hope that they give a good impression about the variety of formative forces hidden in honey. We have dedicated many years to this interesting study and never get tired of trying any specimens we may be given again and again. Honey is a very valuable substance, which is scarcely enough appreciated, as far as its nutritive and remedial qualities are concerned.

Let us turn from honey to Saccharin for a moment, which is three hundred times as sweet as cane sugar, but has no nutritive value whatsoever. It tastes like sugar, but just is not sugar. What formative forces can we find in Saccharin? Figs. 296 and 297 answer this question. No formative force can be found with the capillar dynamolytical test, neither with gold chloride nor with silver nitrate. The slight indentations on the borderline cannot be compared with any of the sugar or honey experiments. It is a completely dead product.

Rudolf Steiner's advice regarding the feeding of bees with sugar.

Sometimes it happens that the bee keepers have to feed their bees in winter with sugar. It is unnatural for bees to feed on sugar instead of on nectar and honey. Their metabolic system is burdened with the task of transforming sugar into honey and weaker bees may not be able to do this. Rudolf Steiner advises adding to the sugar camomile tea, thyme and some salt. He explains that, taking the flowers of the camomile plant, that part of the plant is used which prepares the nectar. Every plant contains potential honey and the camomiles contain this process in an even greater degree than other plants. On several occasions we have pointed out in this publication, that it is essential to study the processes, not only the substances; that, for instance, the silica process embraces much more than the silica substance; thus we have to study the process which leads ultimately to the substance honey. In the camomile plant there is hidden a process which directs the sugar sap of this plant towards the formation of honey. Therefore if we add to the sugar camomile tea we introduce the process of honey formation. Rudolf Steiner goes so far as to say: we make the sugar like honey. Some salt is added, because salt helps to digest otherwise indigestible things.

We wondered if it would be possible to find an experimental proof for this statement of Rudolf Steiner. Having studied carefully the various sugars and kinds of honey and also the camomile plant (Part III, Chapter V, Fig. 206) we made a test with camomile tea and thyme followed by gold chloride, see Fig. 298.

The experiment shows considerable changes compared with the extract of camomile alone, mentioned before. It demonstrates the effect of Thyme added

to the camomile extract. The next experiment consisted in adding sugar to the camomile-thyme mixture.

The result is surprising. We have to study objectively the difference between Fig. 206 in Part III, Chapter V (Camomile alone), Fig. 298 (Camomile and Thyme), Fig. 299 (Camomile, Thyme and Cane Sugar), Fig. 272 (Cane Sugar). We can recognise the influence of sugar ; we can find some characteristics reminding us of the camomile experiments, but there is something more expressed in the forms of the last experiment. We turn our eyes to the various honey tests and find some similarity with Fig. 286 (Greek Honey). It is not identical with Greek Honey, but a process has been initiated which tends towards honey. This tendency becomes clear when comparing the experiment carried out with Greek Honey and the other one with Camomile, Thyme and Sugar. If the necessity arises to feed bees it will certainly help them if Camomile, Thyme and some salt is added to the sugar. The correct formula for this purpose is : —

65% sugar

25% water

10% camomile tea with thyme

1 gram salt.

The camomile tea is prepared in the following way : Bring water to the boil, add 5 grams of dry camomile flowers to 100 cc water and 0.5 grams of dry thyme, cover the pot with a lid, let the tea simmer for 5 minutes, then, keeping covered, allow to cool. From this tea 10% is added to the above-mentioned recipe.

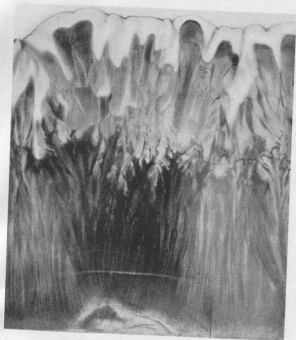


Fig. 271
Sugar cane followed by 1%
gold chloride

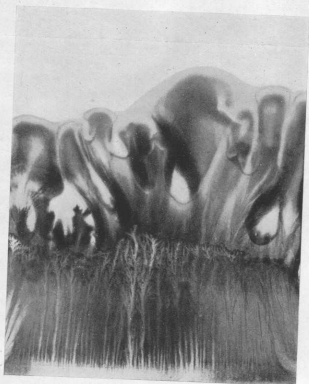


Fig. 272
Cane sugar (yellow) followed
by 1% gold chloride

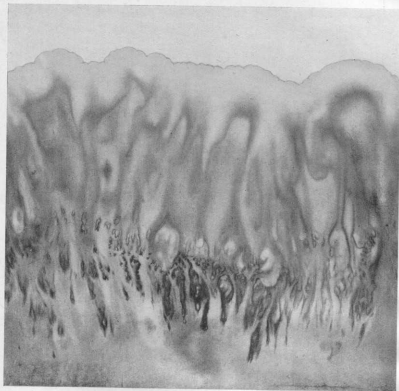


Fig. 273
Sugar Beet
followed by
1% gold
chloride



Fig. 274
Beet Sugar followed by
1% gold chloride

Fig. 275
Maple sugar followed by
1% gold chloride

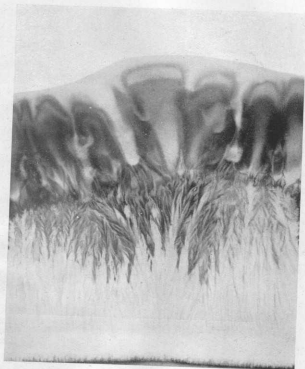
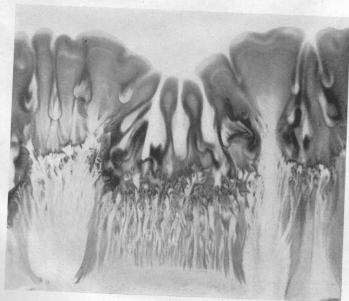


Fig 276
Golden syrup
followed by 1%
gold chloride



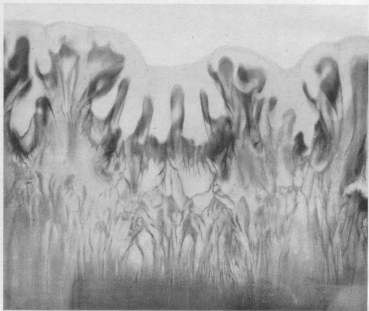


Fig. 277 Golden syrup followed by 1% gold chloride

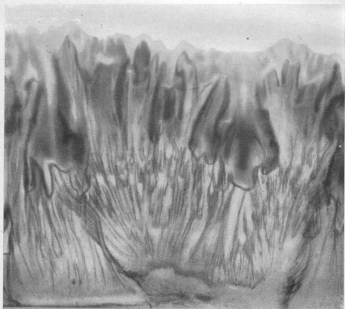


Fig. 278 Dried fig followed by 1% gold chloride

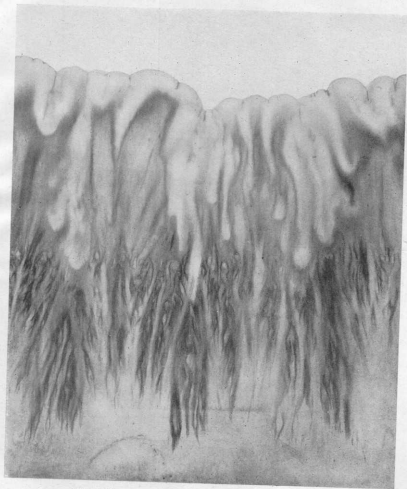


Fig 279 Dates followed by 1% gold chloride

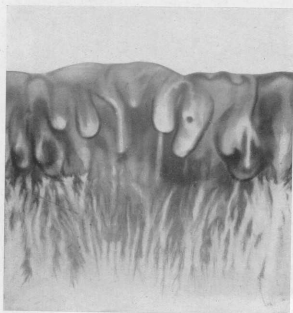


Fig. 280
English honey followed by
1% gold chloride

(Gloucestershire)

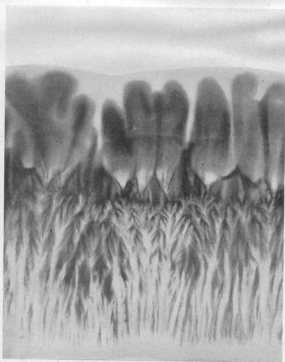


Fig. 281
English honey followed by
1% gold chloride

(Berkshire)

Fig. 282

*English honey followed by
1% gold chloride*

(Yorkshire)

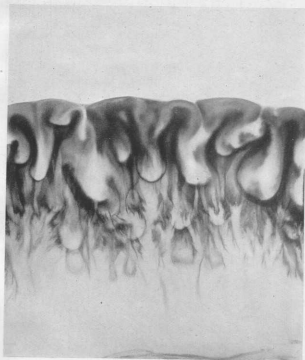
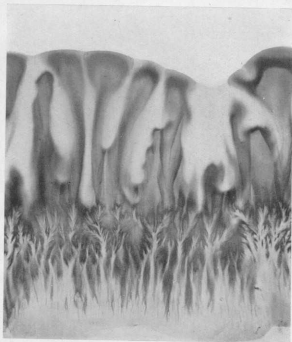


Fig. 283

*English honey followed by
1% gold chloride*

(Otterburn Heather)

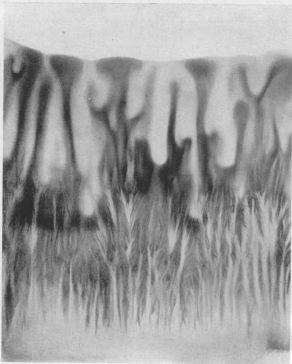


Fig. 284
Swiss honey followed by
1% gold chloride

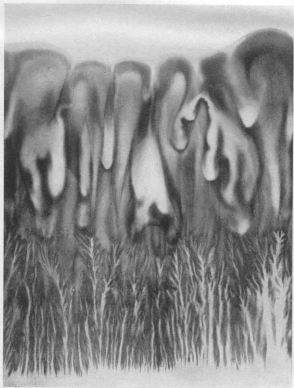


Fig. 285
Tyrolean honey followed by
1% gold chloride

Fig. 286

*Greek honey followed by
1% gold chloride*

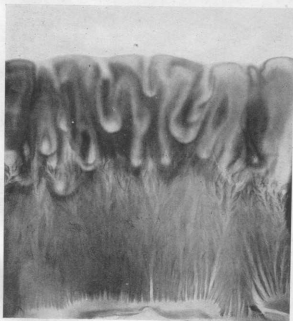
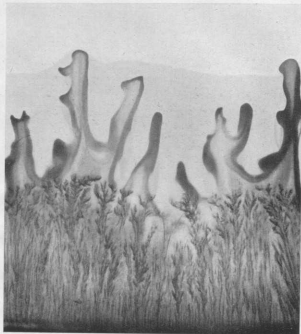


Fig. 287

*Honey blended with invert
sugar followed by
1% gold chloride*

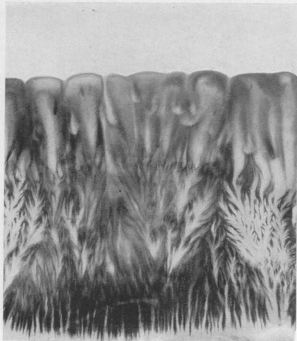


Fig. 288
South African honey
followed by
1% gold chloride



Fig. 289
South African honey
followed by
1% gold chloride

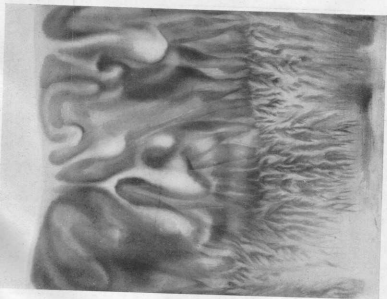


Fig. 290
Californian honey followed by 1% gold chloride

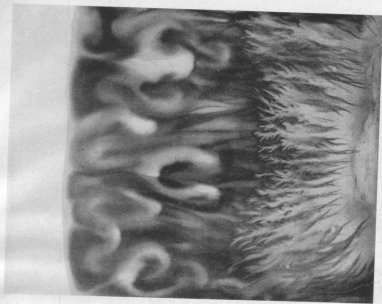


Fig. 291
Californian honey followed by 1% gold chloride

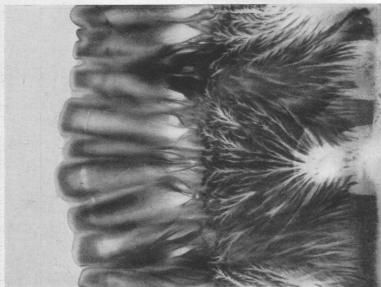


Fig. 292

New Zealand honey followed by 1% gold chloride

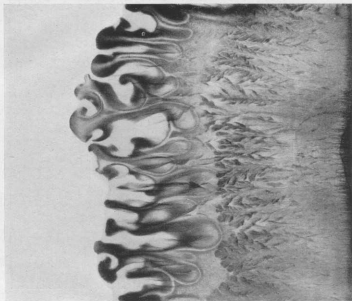


Fig. 293

New Zealand honey followed by 1% silver nitrate



Fig. 294
New Zealand honey followed
by 1% gold chloride

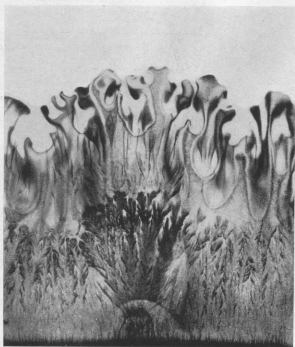


Fig. 295
New Zealand honey followed
by 1% silver nitrate

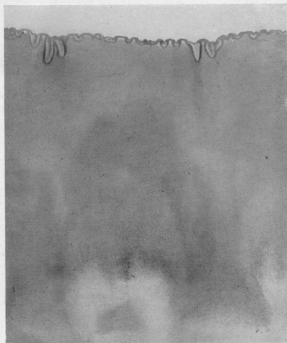


Fig. 296
Saccharin followed by
1% gold chloride

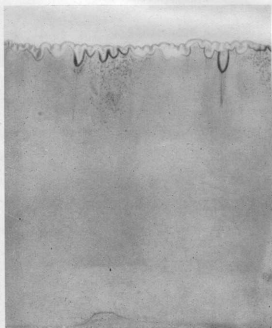


Fig. 297
Saccharin followed by
1% silver nitrate

Fig. 298

*Camomile and thyme
followed by
1% gold chloride*

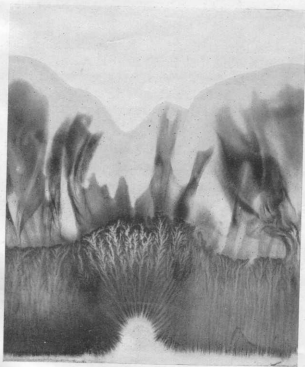
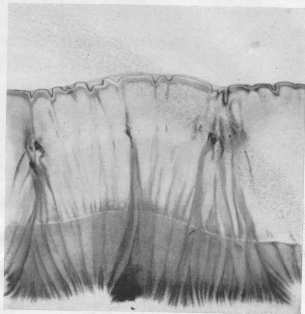


Fig. 299

*Camomile, thyme and cane
sugar followed by
1% gold chloride*

FOOT-AND-MOUTH DISEASE.***Its Nature and Treatment**

In the last few decades epidemics of foot-and-mouth disease have become increasingly widespread and devastating in their effects, both in Europe and in America. Remarkable research work has been done in the effort to elucidate its nature and treatment. But, in spite of this, it cannot be said that we have gained a full insight into the nature of this mysterious malady, or obtained any really satisfactory method of cure. One might even say, that to-day no attempts at all are made to cure the diseased cattle; it seems easier to kill them as soon as possible, burn the bodies and compensate the farmers. Millions of pounds are wasted.

In the following pages we propose to report on experiments that have been made with a new remedial and prophylactic treatment for foot-and-mouth disease. Though these experiments are still in their initial stages, one can already be convinced that they will lead eventually to a successful method of combating the ravages of this disease. The application of the remedy, described here, is not the result of arbitrary or merely empirical experiments. It is the rational outcome of a lively conception of the nature of the disease itself. In this, as in all scientific work, clear theoretical insight provides the strongest and most fruitful impulse to overcome the difficulties which may arise, to begin with, in the practical realization of a remedy or discovery.

The suggestion of treating foot-and-mouth disease on the lines described here was due to the indications made by Dr. Rudolf Steiner. His indications as to the cause of the disease, and as to the specific remedy which would counteract it, led us to prepare the remedy, to undertake the tests and investigate its effectiveness in practice. In the course of this work we gained many important points of insight into the nature of the disease itself.

The tests were undertaken by the Biological Institute at the Goetheanum in Stuttgart, which was transferred some years ago to England.

The possibility of carrying out numerous experiments during the epidemic of 1920-22 in Württemberg (Germany) was due to the co-operation of the veterinary surgeon, Dr. J. Werr, to whom we express here our sincerest thanks.

The effect of the remedy will best be understood if the particular conception of the nature of foot-and-mouth disease, which we believe to be essentially the true one, is first explained in detail from the actual symptoms of the disease. The connection between the remedy and the essential nature of the disease will then become apparent.

* A pamphlet written and published by Dr. E. Kolisko many years ago. Revised and enlarged by L. Kolisko.

The great variety of symptoms and phenomena of the disease may briefly be described as follows :

After the initial fever, inflammatory blisters or vesicles appear in different parts of the body, especially about the mouth and feet. They are either quickly healed, in which case the disease comes to an end, or else serious changes take place in the inner organs, in the intestines, for example, and above all in the heart. These changes are often fatal. It is of great significance, that the disease of the inner organs, especially the heart, is generally the less evident the more the vesicles and resulting sores appear. The most severe cases are those which show the foot-and-mouth symptoms least, but in which the heart symptoms, on the other hand, become apparent at an early stage. We have to do with a disease process which is either overcome by the animal through the formation of vesiculæ following on an initial fever, or else results in a destructive disturbance of the heart.

To prevent the morbid condition of the heart from setting in, or to counteract it as soon as it has begun, is the task of a remedy for foot-and-mouth disease.

We need only study the course of the fever to recognize that there are in a certain sense two phases of the disease. There is the initial fever which appears on the first day of the illness and introduces the forming of the vesicles. A second stage of fever appears about the fifth, seventh and ninth day of the illness. Its maximum is almost invariably a little below the maximum of the initial fever. This second fever must be regarded as the critical and decisive stage. In a lesser degree it is nearly always to be detected, even in the lighter cases. After it, the general condition will either return to the normal, or else a very sudden fall of temperature will be followed by a rapid decline, and progressive deterioration of the cardiac condition leads to a fatal issue.

Thus the first fever indicates the approaching formation of the vesicles, while the second fever points to the characteristic morbid symptoms of the heart. (The connection of the second fever with the morbid processes in the heart was notably established by Dr. Werr, who had a large number of cases under supervision during the epidemic in Württemberg in 1920-22.)

If the vesicular symptoms predominate and the disease comes to an end at this stage, we are dealing with the so-called lighter form of the epidemic. The malignant form, on the other hand, is characterized by the early appearance of heart symptoms. Nevertheless, the disease process is essentially the same in the two cases ; it only expresses itself more in the one direction or the other.

The first phase of the Disease—Foot-and-Mouth Symptoms

The first phase of the disease is characterized by the forming of vesicles, which may extend to many parts of the body. The blisters appear especially on the mucous membrane of the mouth, particularly the tongue, the hard palate, and the upper lip. They are more like boils than blisters. Often they develop so rapidly as to coalesce and as a result the epithelium is shed over large areas of the mucous mem-

brane. This is accomplished by salivation and excessive nasal secretion, which may be exceedingly profuse, so that quantities of ropy secretion hang from the animal's mouth and nose.

One has the impression that the most sensitive part of the mucous membrane of the digestive tract, namely the mucous membrane of the mouth, which is richest in sensory and nervous elements, is being expelled as a foreign body from the organism, with a most violent reaction.

The other situation of these intense morbid changes is in the region of the **hoofs**. Here the vesicle formation can be perceived at an early stage, on the third or fourth day of the illness, in the cleft of the hoof and on the ball of the hoof. In the more severe cases they appear right inside the hoof. The vesicles take their start from the epidermis in the cleft and become prolonged under the hoof, forming long narrow cavities with severe suppuration. Eventually this may lead to a complete severance of the hoof.

Why is it that the reaction takes place just at this point? Because here in the hard, horny layers of the hoof, the metabolic forces are to a certain extent impeded. Even in the normal condition, the hoof acts to some degree, like a foreign body, damming up the free flow of the body fluids. It is here that the eruptions can show themselves most strongly. The natural process of healing, which tends completely to eliminate the hoof that has become like a foreign body to the organism, can be assisted and forestalled by a proper surgical treatment of the hoof, room being made by excisions for matter to flow out.

The blister formations in mouth and feet are undoubtedly the most important, and such blisters as are formed in the other parts of the body, for instance on the udder and on the tender skin of the breast and belly, are of secondary significance. A general eruption never occurs. The reaction remains more or less inside the animal and only finds its way to the surface in those parts of the body which are in any case most highly developed in the ox. That is to say, it goes towards the mouth and the digestive tract, and to the skin of the belly, legs and feet.

From the very outset of the disease a certain apathy, anorexia, and in many cases an expressionless kind of stare, can be observed in the animal. The sense organs are no longer directing their activity, as in the normal condition, to the impressions of the outer world. The activity of the brain, too, is lowered. The sensorium is slightly dimmed. The senses and the brain are to some extent isolated from the rest of the body and turned inwards. Instead of the normal reaction to the impressions of the outer world or, again, instead of the normal secretion of digestive juices in the digestive tract (for there is nearly always marked constipation) widespread secretions occur in the mucous membranes, and other secretions too, which often become purulent.

To sum up, we have the impression that the sense organs and especially the nervous system are becoming isolated from the rest of the body. To avoid misunderstandings, we must here draw attention very definitely to an aspect that has hitherto been insufficiently considered. A satisfactory solution of many physiological problems

will not be found if we do not enter into the fundamental fact, that both in the human and in the animal organism two kinds of processes are to be found, which are fundamentally different, nay, opposite, to one another. The one is the activity in the **nervous system**, which is especially concentrated in the brain and sense organs, i.e., in the head. The other is the **metabolic activity**, which takes its start from the digestive process, and has, moreover, a main focus of activity in the tissues of the limbs.

The system of nerves and senses comprises, in the first place the brain and the sense organs, also the spinal cord and its nerves. While it is concentrated mainly in the head, this system radiates out to the whole body. There is no part of the animal or human organism void of sensory and nervous activity. Nevertheless in the head this form of activity predominates.

Again, the metabolic-muscular system comprises, in the first place, the large abdominal digestive organs and the legs, where, as we know, in the muscular movements, a most important part of the metabolic process takes place. While in the digestive organs the substances are received and elaborated, the main consumption of metabolic products takes place in the muscles, especially the limb muscles. The movements of the limbs may increase the metabolism by as much as 50%, but there is no part of the organism that is not also permeated by metabolic activity.

Countless other points of contrast may be found between the two systems. For instance, in the head there is relatively most of the bony substance. Here the hardening process has gone farthest. The nervous substance itself, which is relatively predominant in the head, is the least capable of regeneration; it has the least vitality, its metabolism is slow and dull. The opposite is the case in the lower (or hinder) portions of the human (or animal) body. Here there is comparatively little hardening, but much vitality and mobility of metabolic processes. Upward in the human body there is much consciousness and little life, downward there is much life and little consciousness.

Without taking these elementary contrasts into consideration, we cannot do justice to the real processes in the living body. The wealth of facts, so wonderfully collected and described in modern science, in anatomy, physiology, and pathology, remains more or less chaotic and unorganized without these guiding principles.

Between the head processes and the metabolic processes stand those of *respiration* and *circulation*. They are of a **rhythmical** nature. Respiration, concentrated in the lungs, is nearer the activity of the nerves and senses, than is the blood circulation, which springs from the metabolic process and is concentrated in the heart. The former, too, is more conscious than the latter. Both have their centres in the chest, i.e., in the middle part of the human or animal body. Nevertheless these rhythmical processes too are spread over the whole body, for the breathing activity works everywhere, and there can be no part of the body without blood circulation. The division here indicated, which was first described by Rudolf Steiner in his book *Riddles of the Soul*, is not a sharp division in space, but a **dynamic**, functional division. It only finds spacial expression, to a certain degree, in the upper, lower, and middle

portion of the body. Where there is most nervous activity functionally, there, too—in the brain and senses—the nervous system is most apparent, and gives to the head its characteristic shape and character, and so on.

Regarded from this point of view, foot-and-mouth disease appears as an interruption of the proper connection between the nerves-and-senses system and the rest of the body. To begin with, the apathy, the expressionless stare, the slight disturbances of consciousness, point in this direction. Then we have the disease of the feet. The horny formation of the hoofs belongs to the skin. They are thickenings of the surface layer of the skin, and this, genetically, is derived from the nerves-and-senses layer of the embryo—from the ectoderm. In the suppurative process the hoof becomes a foreign body. It becomes isolated and at length eliminated. So it is when other portions of the skin, on the udder and the belly, for example, are attacked. On the other hand, it is only in rare cases that vesicles are formed about the horns, and in very rare instances an inflammation in this region has been followed by the loss of the entire horn. But as a general rule, we have the impression that the resistance is too great in the region of the horn, and the flow of the fluid, returning thence, seeks other outlets.

Finally, we come to the mucous membrane of the mouth. Though not belonging directly to the system of nerves and senses, the mouth, of the whole region of the digestive tract, is most permeated by sensory and nervous elements. It is the most sensitive; thus it is the seat, for example, of the sense of taste. It too becomes like a foreign body in foot-and-mouth disease, and the more it becomes isolated, the greater is the secretion of saliva and of other fluid in the vesicles. In place of the normal sensory function and digestion we have salivation, blistering, a process which eventually goes farther inward towards the intestines, producing hæmorrhage and diarrhoea.

The conditions are very similar to this in the second stage of **canine distemper**, where there also occurs a reaction (though in this case it is far more general) of the metabolism in the mucous membrane against the isolation of the nervous system. The vesicular eruptions in the mouth may pass over to the mucous membrane of the paunch and other stomachs, and in the end the whole of the intestines, including the rectum, may become involved. Here the vesicles and ulcers only differ from those in the mouth by the greater effusion of blood into the vesicles and the more rapid loss of the epithelium. Thus at various places in the intestinal canal, we find intensely red foci of inflammation suffused with blood, also erosions and swellings of the mucous membrane. These are generally more intense and numerous in the stomachs than in the intestines. The disease may lead to a complete disintegration of the mucous membrane, giving the picture of a severe gastro-enteritis, which may end fatally. In such cases the faeces are generally hard and dry, or they may be covered with blood and mucous. Severe constipation occurs, one of the most important symptoms of the disease, but there may also be diarrhoea, especially in the later stages.

This internal or gastro-intestinal variety of the epidemic represents a form of disease in which the symptoms are already transplanted far more deeply into the inner parts of the organism. It is as though the process were no longer able to express itself outwardly to a sufficient extent; the inner organs also become diseased. Haemorrhage takes the place of a secretion of mucous and the mucous membrane becomes isolated even in those parts where it is normally given up to the forces of the metabolic and digestive system. It is a long way from the hoof (which is more or less isolated from the very start, and in which the hardening forces of the nerves-and-senses system are even normally predominant) to the mucous membrane of the stomach. It may not be out of place at this point to recollect how much more frequently **sheep** and **goats** and even **pigs** become diseased in the hoofs only. In these animals the process remains more in the periphery; in them the feet are relatively more important. In the ox the process tends to go inward; hence the great danger of foot-and-mouth disease in cattle.

In earlier epidemics the eruptions on the udder and elsewhere seem to have been more frequent, but in the devastating epidemics of recent years the inward morbid symptoms were increasingly predominant. Even among sheep and goats severe epidemics accompanied by fatal cases have occurred. The more the isolation of the nervous system extends to the spheres which essentially belong to the metabolic and rhythmic systems, the less can the reaction express itself in colourless secretions of mucous, etc., and the more does it take on the dangerous forms, with deep-seated lesions. Thus, the internal, gastro-intestinal form of the epidemic is a transition of the profounder changes of the second phase of foot-and-mouth disease—namely, the implication of the **heart**.

The second phase of the illness : the affection of the Heart

The second phase is characterized by the heart symptoms coming into the foreground. In these cases we speak of the malignant form of foot-and-mouth disease, which has been especially predominant in the severe epidemics of the last few decades. The intensity of the destructive process with which we are faced here, shows itself most of all in the morbid changes which we find in the heart on post-mortem examination. We find greyish-red and greyish-yellow spots throughout the whole musculature of the heart. The heart looks brittle, clay-coloured. It often looks, as though it had been boiled. Microscopic examination shows the muscular substance broken up into minute lumps and fragments. Haemorrhage and far-reaching degeneration of the entire heart muscle is the characteristic picture in severe cases. Sometimes the heart is altogether flabby and can easily be pressed inward with the thumb. The right ventricle is frequently distended. In other cases the changes are outwardly less noticeable, but inwardly we find the heart filled with the above described clay-coloured centres of degeneration. It has a mottled appearance.

We nearly always find considerable effusions of blood in the endocardium and pericardium. We may say that in this morbid process there is a tendency completely to destroy the heart.

How these appalling changes in the heart gradually come about is far more intelligible when we have observed the changes of the pulse from the very first days of illness, especially in a severe epidemic. Even in the stage of initial fever the pulse beats are more rapid, and the breathing too is accelerated. Indeed especially in severe cases, there is scarcely a moment in the whole course of the illness when the rhythmic system, expressing itself in breathing and blood circulation, is not disturbed. The preliminary stages of the heart affection are soon recognizable in the increased intensity of the beat, which is at first accelerated and then, in many cases, very much retarded. As a rule, more or less pronounced murmurs and cardiac arrhythmia are sooner or later to be observed: often there are dropped beats. These phenomena are frequently accompanied by a deep-seated disturbance in the distribution of the bodily warmth. The legs and ears feel cold, and as the heart symptoms grow worse, the bodily warmth gradually withdraws inwards from the periphery of the animal in a most alarming way. Starting from the extremities and working inward, the animal grows cold.

During the epidemic in Germany in 1920-22 we had occasion to examine many animals, particularly with regard to these heart symptoms. We found that they begin shortly after the initial fever has set in, while the rapid formation of vesicles is in full swing. Especially the intensified heartbeat, the least severe of these symptoms, shows itself very early in many cases. This is very significant: it means in effect that the initial stages of heart degeneration are present even in those slight cases in which the affection of the heart, properly speaking, never occurs and only the foot-and-mouth symptoms become visible. The disease process therefore is a unity. Even in the very slight cases, which stop short at the first phase and where this phase alone comes to expression, there are always suggestions of a progressive disease of the inner organs. Conversely, there is no form of the disease, however malignant, in which the characteristic vesicles in foot and mouth do not appear in some degree.

What, then, do the heart symptoms signify? To begin with, the interrupted connection between the nerves-and-senses system and the rest of the body showed itself in an intense reaction in the more peripheral organs. Now it shows itself directly in the centre of the blood circulation, which has above all the task of maintaining this connection. The heart is the organ in which all the contrasts of the upper or nerves-and-senses system are balanced and harmonized. Here, in its very centre, the rhythmic, balancing system is now destroyed. The more malignant the epidemic (the more its real nature becomes apparent) the earlier do we observe the fact in the morbid changes of the heart. The destruction of the heart is the full and final expression of the destruction of the circulation of the blood, which regulates and balances all the contrasts in the body.

"Fodder and drink are refused, defaecation is infrequent or absent altogether, the eyes are closed, the feet and tail are cold to the touch, the temperature is 98.6 to 99.4 degrees, the pulse quick, feeble, and intermittent; the heart beat loud and

strong. Occasionally the animal holds its head towards the heart and remains in this position for five or even ten minutes. The body sways as the animal moves about and often it falls down and dies on the spot.”*

In this description of the final stage, the real essence of the disease is fully and completely expressed. On the one hand, there is the lowering of consciousness, the senses and the brain activity are dim, while on the other hand digestion and limb movement are more or less paralysed. The head and hindquarters of the animal confront each other like lifeless masses, deserted as it were by the life-giving circulation, while between them—hopelessly palpitating—is the destroyed and swollen heart.

In the heart the influences of the two systems meet; hence the heart is in all respects so very largely autonomous. It contains as it were its own “brain” and its own “nourishment.” It is the only organ with a nervous system, sharply distinguished both from the sympathetic and from the central nervous system, while through the coronary cycle it nourishes itself as it were by its own function. The sensory element, sense perception, consciousness, which are predominant upward in the head and brain—and the motor element, which expresses itself above all in the muscles of the limbs and the digestion, are united in the heart to a single unity. Hence in the heart we even find the nervous substance (the sensory element) far more like the muscular substance (the other element) than anywhere else in the body. In such considerations we come far nearer to the essential nature of the heart than when we compare it with a pump. It is at this most independent centre in the organism that the morbid processes of foot-and-mouth disease makes its attack in the later stages.

From the very outset it is the rhythmic system that becomes involved when the epidemic begins to assume a dangerous form. So long as the balance between the systems, separated by the disease process, is still maintained by the serous fluid which pours into the peripheral increasingly isolated regions of the nerves-and-senses system, the danger is averted, the circulation still performs its function, though abnormally, through the reaction of the metabolic system to the disease. But in course of time this grows more and more difficult. Effusions of blood take place into the inner organs, and at length the circulation itself becomes diseased in its central organ. But in these malignant cases the approaching heart affection is evident at an early stage. Watching the course of a case of foot-and-mouth disease, we are in fact constantly listening to the heart and to the breathing. For here the eventual outcome is decided.

When the second fever has taken its course, the heart symptoms often disappear quite suddenly. Then the animal has overcome the crisis. Or else, the heart symptoms grow worse and worse and threatening symptoms occur. Death most frequently occurs in the way above described, between the fifth and eighth day. There are also cases when the animal appears to recover, but during convalescence suddenly falls down dead. This happens especially in powerfully built animals.

* Dr. Carlo Rossi. *Practical Observations on the Malignant Form of Aphtous Fever*, “*Berliner Tierärztliche Wochenschrift*,” 1901, page 495.

Animals which have passed the crisis, regaining their appetite and beginning to give milk again, suddenly collapse. Dr. Werr once saw a half-year-old calf, while an attendant was giving it water, fall down as though struck by lightning. On another occasion a young cow fell down dead, just as he was about to auscultate it. This death in the convalescent stage—on the fifth or eighth day, or even later—is really a kind of apoplexy. Though the circulation is re-established the degeneration of the heart has gone so far, that sooner or later a sudden collapse takes place. In such cases we often find haemorrhage in the brain between the dura mater and the arachnoidea.

To sum up all that has been said, what is foot-and-mouth disease in its real essence, and what must be the task of a specific remedy for this disease? The disease process consists in this : that the connection between the nervous system with the rest of the organism is interrupted by a disturbance of the rhythmic system. This morbid tendency, if it cannot be brought to a standstill by the reaction of the whole metabolic system, brings about a destruction of the heart—the central organ of the rhythmic, balancing process. To strengthen the rhythmic system, to re-establish the connection when disturbed, to stimulate the circulation in the nerves-and-senses system and especially towards the brain, to restore the digestive activity to its normal condition—in short, to repair the disturbed rhythm and re-unite the upper and lower systems—such is the task of a remedy for foot-and-mouth disease. Where in nature can such a remedy be found?

Treatment :

The remedy which has the property of restoring the impaired rhythm in the way above described is given us in the seed of the coffee plant. The use of this was indicated by Dr. Steiner. The coffee seed must undergo a special preparation for the remedy to be effective.

We must now indicate the connection between the specific effect of this preparation and the symptoms of foot-and-mouth disease. The effect of coffee is exceedingly characteristic. It shows itself especially in the influence on the brain. Small quantities have a stimulating effect. Our senses become more acute. We find it easier to link together thought with thought. Coffee induces in us a kind of automatic logic, enabling us to think in this way without much effort. "Increased sensibility of sight, hearing, and touch, a powerlessness to check the quick rise of successive thoughts, shining eyes, a hot head, sleeplessness, redness in the face, and a feeling as though one's head were too small for one." Thus an excellent observer, Kent, describes the symptoms of the effect of coffee on the human being.

Larger quantities, as is well known, give rise to congestion in the head, sleeplessness, and migraine-like conditions.

Coffee, indeed, gives rise to cerebral hyperaemia, accompanied by palpitation and quickening of the pulse. Under the influence of excessive coffee, we live with the whole force of our consciousness in the nerves-and-senses system of the head. The cerebral circulation is increased to the utmost.

Coffee has a powerful regulating effect on the digestion. Diarrhoea can be cured by it and constipation relieved. Altogether it facilitates digestion. Hence the beneficial effect of coffee after meals, and in many cases of digestive disturbances.

These effects are well known. But they appear in far greater measure if the coffee seeds have been prepared by the special process referred to above. The effect of coffee is shown in a most interesting way when the preparation is injected into the veins. In the Biological Institute of the Goetheanum we injected it into a large number of bullocks, etc., both in the treatment and prophylaxis of foot-and-mouth disease and in testing the effect on healthy animals under widely different conditions. When one undertakes an intravenous injection with this preparation one is astonished at the extraordinary powerful effect, an effect which to our knowledge has never yet been described.

We let the warm fluid (at blood heat) flow from the irrigator into the vein. After a certain quantity has passed in (the point at which it happens is an individual matter for each animal) we observe, on auscultation, a quickening of the heart beat, which is then followed by an increasing retardation. At the same time the heart beats grow stronger and stronger. At length, when it has slowed down, often to forty or even fewer pulse beats to the minute, it suddenly begins to beat again more quickly. The pulse may then become weak and racing, and we often observe distinct arrhythmia. Even while the pulse is growing slower, there is an acceleration of respiration, and in many cases the animal snorts audibly. Frequently too, it quivers. As the heart beat become arrhythmic, the animal stares in an expressionless way. Another constant effect is the passage of water and faeces sometimes during the injection, but as a general rule immediately afterwards. If we now continue the injections, the animal becomes unsteady and begins to sway, especially in its hind-quarters. It may then fall down suddenly as though struck by lightning, whereupon the injections should be discontinued. The creature then immediately regains consciousness and stands up. A few minutes later the symptoms have passed, with the exception in some cases of quickened respiration and snorting, which may continue for an hour or two.

These reactions are not shown in their completeness by every animal. There are many varieties according to breed and individual characteristics. Sometimes there is cardiac arrhythmia; the heart beat, having been retarded, slowly returns to the normal, the breathing becomes quiet, and further injections even with larger quantities produce no reaction. Sometimes the reaction is small, but snorting and quivering begin two or three hours later. In these cases there are no accompanying heart symptoms and the effect quickly passes over. There is also a great difference in the volume of the injected fluid at which the several phases of reaction occur. Sometimes a small animal needs 40 c.c. and a powerful bull only 20 c.c. The rapidity of injection is also of importance. If injection is very rapid the reaction takes place more quickly and is altogether more intense. But even if the speed of injection is standardized and kept constant through many successive tests, the individual differences occur.

With the large number of injections we have carried out no healthy animal has ever died, nor have any undesirable after-effects or disturbances appeared. The above described reaction gives us a clear insight into the effect of our coffee preparation. What is it that happens?

To begin with the heart : first, the heart beat is quickened, then it becomes retarded. The retardation expresses the preponderating effect of the brain activity, which is stimulated by the coffee. The acceleration of the heart beat expresses a quickening of the metabolism. So we see the heart beat expresses a quickening of the metabolism. We see the heart in quick succession come under the preponderating influence of each of the two opposing systems. First the coffee stimulates the digestion and regulates it, as is shown in the excretions which occur immediately after ; then the effect on the brain becomes evident and cerebral hyperaemia sets in. Thus the coffee clearly mediates between the two systems and shows its effects in the very centre of the circulation, in the heart.

The breathing too, is strongly influenced, respiration becoming greatly accelerated. The function of respiration is to establish a balance between arterial and venous blood, between the lungs and the blood circulation. To stimulate respiration is to intensify this balancing process. The brain symptoms show that there is a very powerful influence on the blood circulation in the brain. Moreover, in post-mortem examination of cows that had been treated experimentally with a rapid succession of strong intravenous injections, we had occasion to observe an extraordinary excess of blood in the brain. In one case there was even an infusion of blood into the lateral ventricle.

The totality of these symptoms presents the very counterpart of the picture of foot-and-mouth disease. Peristalsis is at once re-established, normal metabolism, which had been impeded, is restored, respiration is stimulated, and the heart itself undergoes a quick process of successive acceleration and retardation—a process which otherwise spread out, as it were, throughout the whole illness. After this the heart beat becomes regular and rhythmical once more. It is also interesting to observe, as we have often done, the cardiac arrhythmia and murmurs, which had been present before throughout the disease, ceased during the reaction caused by the injections. And though they returned to some extent after the injection was over, the heart was nevertheless in a far better condition than before.

In the intravenous injection of this coffee preparation the essential point is the shock effect which is required to counteract the illness. The injection must be made directly into the blood stream, because it is the rhythmic system, the heart and the blood circulation, which must be influenced as much as possible. A strong effect must be made to direct the circulation from the sick and overloaded heart to the brain.

We made many experiments with subcutaneous injections of smaller quantities of the preparation for foot-and-mouth disease. But in the end the method of intravenous injections proved to be the best, suitable both for the therapeutic and the prophylactic treatment of this disease.

In the pamphlet *Canine Distemper*,* it is mentioned that the effect of the preparation has nothing directly to do with that of caffeine. The specific effect of coffee is indeed far more connected with the products that arise when the coffee is roasted. This has long been known.† And indeed the above described complex of symptoms produced by intravenous injections is completely divergent from the effects of caffeine. It is the effect of the coffee plant as a whole (i.e., of the seed) with which we are dealing here. The peculiar method of preparation, serves only to intensify the effect of the seed. In the pure alcaloid caffeine we have only a part, and not even the most effective part of the natural process which is present in the plant as a whole, and in its seed. It is the whole process, not the extracted alcaloid, which we bring into the system. It has indeed been insufficiently perceived how frequently nature's processes as a whole are more effective than the extracted or synthetic chemical substance. (See the Chapter about "Vitamins" in this book.)

If the intestinal symptoms are predominant in the epidemic, if we are dealing with the symptoms of the gastro-intestinal form of the disease, if there is abdominal distension and peristaltic inactivity, **the remedy may be given internally as well.** 100 c.c. are then poured in the animal's mouth from a bottle previously warmed. The dose can be repeated if necessary a few hours later. The result is a quick resumption of peristaltic activity, with adequate evacuations. The effect always occurs with astonishing regularity. Of course the remedy must be applied as early as possible, before the serious heart symptoms occur. Much depends on the circulation being revived and diverted before the heart has suffered far-reaching disintegration. One injection is given, and if improvement does not set in at once, or if the condition declines again after improvement, a second is given one or two days later. A third injection will scarcely be necessary. The interval must be at least twenty-four or thirty-six hours; otherwise there will be no reaction. For it is only after this period that the animal once again is receptive in the way above described to the influence of coffee.

In this treatment everything depends on the success of this characteristic reaction. There must be a strong shock effect. This applies above all to the prophylactic injections of which we shall speak below. The remedy is therefore a specific one against foot-and-mouth disease. We recognized the essence of the disease in a completely interrupted connection between the nervous system and the metabolism as a whole, with a consequent inflammatory reaction of the whole body, which followed eventually by a destruction of the heart, which is the central organ of the rhythmic system. The peculiarly prepared coffee has to re-establish the broken connection and thus to heal or preserve intact the heart, which is endangered by the illness.

* Dr. Eugen Kolisko.

† Cf. W. Neumann & Lehmann. "Does Caffeine play a part in the Specific Effect of Coffee?" *Dissertation*, Würzburg, 1895. *Archive for Hygiene*, 32.

The Preparation of the Remedy

As already mentioned the coffee seed must undergo a special preparation for the remedy to be effective. When we started with the treatment of foot-and-mouth disease we often met with the difficulty that the remedy was not always of the same effectiveness. Dr. Steiner then pointed out, that the roasting process of the coffee seeds had to go just so far, that a **specific change in the protoplasmatic structure of the cells occurs**. Only then the coffee seeds are the remedy for foot-and-mouth disease. That is really the most important point. We started immediately with the microscopic tests and after a long time of investigating into the structure of the cells, having tried many different methods of preparing microscopic cuttings and histological dyes, we had to confess we were unable to find any structural change. At last we asked Dr. Steiner to examine the different microscopic tests and he found some containing the changed structure.

We particularly want to describe here some of the details of the work which had to be done. Rudolf Steiner has been a great teacher of mankind and it is interesting to see how accurate all his suggestions were. We examined carefully the preparation which he said contained the changed structure of the protoplasm—but quite honestly we did not see it. So we had to go on examining the tests, and months went by with microscopic work day and night, still we did not find the change. The protoplasm looked more or less transparent to us, with no specific structure at all. Then Dr. Steiner advised us to try the microphotographic methods and enlarge as far as possible. "Maybe the camera sees more than your eyes. Professor Römer in Leipzig will help you to get enlargements up to 3,000."

With the help of Professor Dr. Römer we succeeded in enlarging the cells of the coffee seeds 3,000 times. We took many photos in his laboratory at the University in Leipzig, investigated very carefully—but came to the same conclusion: there is no change in the protoplasm. Professor Römer and I were very disappointed that all our trouble proved useless. Then I packed the photos carefully in paper, turning them over and over again before the bright shining lamp and—suddenly, holding the plate at a certain angle to the light, I saw right across one of the huge cells of the coffee seed which nearly filled the whole space of a 9.12 cm. plate, the shadowy outline of a star or cross-like structure. At last we found it. Professor Römer also could see the changed structure. We had made one big mistake in all our investigations. We wanted to see better and better; to enlarge and enlarge the cells; to get the light brighter and brighter—and we just needed a **dimmed** light, falling in at a certain angle. Then I returned to Stuttgart and from that moment I was able to find in the microscopic test the change which makes all the difference if the coffee seeds are to become a remedy for foot-and-mouth disease. Perhaps to-day I would not say that we find a *change* in the structure. It may be better to say, that the protoplasm seems to have no structure at all, it is transparent; and if the seeds have been roasted to a certain degree—or to express it more clearly—if *the roasting process has been interrupted at the right moment*, then and only then this specific structure is to be seen in the microscope.

That is the most important part in preparing the remedy for foot-and-mouth disease. **The eye has to be trained to see the change in the cells. No untrained eye is able to find in the microscope immediately** that particular change. Whoever says, that immediately at the first glimpse he does see in the protoplasm stars and crosses and I do not know what else, simply does not speak the truth.

Later on we passed the prescription for the preparation of this remedy to the "Weleda" Company in Stuttgart, but only so far as it is possible to tell the different degrees of temperature which have to be kept during the different stages of the roasting process. Nobody has been trained to make the microscopic test. It takes a long time to train the eyes and we were always prepared to help in this direction. It is essential to repeat from time to time the microscopic test—or else there is no guarantee that the remedy is really effective.—The more so, if for instance coffee seeds of other varieties are used. Then it is quite obvious that the preparation has to be tested, the roasting may have to be interrupted at another temperature.

Previous Views on the Nature and Treatment of the Disease

There can be no doubt that the epidemics of foot-and-mouth disease have grown far more virulent since the seventies of the last century. The symptoms in the inner organs, especially the heart, have come more and more into the foreground. The devastations caused by the disease are indeed immense.

Since it has been recognized as an infectious illness, the whole interest of research has been concentrated on its bacteriology. The greatest care has been taken and endless work has been expended in the effort to discover the specific micro-organism of foot-and-mouth disease. The subject has given rise to an extensive literature, which will not be described in detail here. It is filled in this case, perhaps more than usual, with controversy and polemics. Many authors have sought to isolate the specific micro-organisms in the diseased organs or secretions. Others again have tried to refute these results, proving them inadequate or erroneous. Even the most recent researches on the subject are still a matter of controversy and are being disputed. We think it is justified to pass over these results without further details—important as they are for our knowledge of bacteria and protista—the more so as the method of treatment for foot-and-mouth disease which we are now indicating is the result of a quite different approach.

We are here proceeding from the picture which the disease as a whole presents. This, we contend, gives us the clue to the real nature of the disease. As a remedy we discover a plant preparation, which in its whole effect, and in all its properties represents a kind of counterpart to the picture of the disease. As such it is a true specific.

We look for the essential nature of a disease and thus for its fundamental cause not only in the micro-organism which is found as an invariable accompaniment, or the artificial introduction of which may result in the outbreak of the disease. It is from the disease as a whole that we must seek to discover the true remedy. If the remedy is a true one, in that it really meets the disease process as a totality, then

it will also have the property of undermining the conditions of existence of the specific bacteria or other micro-organisms. For these can only live and work harmfully if the disease process as a whole gives them the requisite basis, the proper soil and nourishment.

Hence the remedy described here is a specific one, not in the commonly understood sense of killing the causative bacteria—not indeed in that it is directed primarily against micro-organisms at all—but because it represents that product of nature which is the effective counteracting force corresponding to the whole process of foot-and-mouth disease, the latter also being a process in nature. For every disease process, there exists in nature some plant, or mineral, or animal process which represents the corresponding healing process, given the right mode of preparation. We must only learn to find it by seeing the disease process and the corresponding nature process together. It is this possibility which is given by anthroposophical science and it is thus, that the remedy has been discovered. Therefore to explain its mode of action, we had to take our start from the disease picture as a whole, and not from the accompanying micro-organisms.

Once more we must repeat, to avoid any possible misunderstanding, that from this point of view, the magnificent achievements of bacteriological research are fully recognized and valued. But it is another question whether the search for specific causative micro-organisms has contributed much to the discovery of a real remedy for foot-and-mouth disease.

As to the methods hitherto employed against foot-and-mouth disease only the serum treatment and serum prophylactic treatment can be spoken of at all, as having been more or less effective.

We will quote here a judgment by Professor Camillo Terni, director of the Experimental Institute for Combating Animal Plagues in Milan. He wrote during last year: "Though they gave good results in the very severe epidemic of 1918-19, the serum and vaccine treatments cannot be adequately applied in practice, because, in view of the high cost of production and other circumstances, it is impossible to provide the immunizing material in sufficient quantities at a given moment. And though experiments with laboratory virus of various origins have given more than favourable results, our surprises during the last epidemic lead us to be extremely cautious in drawing any practical conclusions. We must experiment and experiment again."

On the remedial and prophylactic treatments in general, Professor Terni writes: "As regards the prophylactic treatments and cures for aphtous fever, we are unfortunately only at the stage of laboratory experiments and can but indicate the way along which our studies will have to proceed."*

With the serum or milk of animals that have gone through the disease once and become immune, and with other sera made in various ways from laboratory virus, short periods of immunity and a certain alleviation of virulent epidemics have indeed been achieved. But the result is by no means completely satisfactory.

* Terni. *Considerazioni sull'attuale ripresa dell'afte epizootica, conferenza tenuta il 23 febbraio alla società.*

The scepticism that still obtains as regards the remedial treatment of foot-and-mouth disease is evident from the fact that the law in England whereby the disease is to be combated by wholesale slaughterings still stands.

As to the chemical preparations which have been recommended as remedies for foot-and-mouth disease (and their name is legion) all authors are really in agreement that no single one of them is satisfactory or even nearly so. Atoxyl, iodine preparations, gliarsanil, mallebreine, salvarsane, iron vitriol, lysol, guaiacol, formaldehyde, and many other antiseptics have failed completely. Almost all of these were chosen and sought out with the idea of their having a bactericidal effect. They are not inspired by an attempt to find a specific remedy for the disease process as a whole. But this is what we have tried to do with the preparation here described.

Foot-and-Mouth Disease and Canine Distemper

Readers may wonder that the same remedy, though in a somewhat different method of application, is recommended for two diseases so very different : foot-and-mouth disease and distemper. It is necessary to show the reason for this. To do so, we shall however be obliged to describe the contrast, between the two animals so widely different as the dog and the ox, in a way which to some may be a little unfamiliar.

It has by no means been sufficiently observed that every animal develops one organ or system of organs especially and is thus subject to a peculiar and one-sided kind of development. Yet this point of view provides the very foundation of sound zoological theory. Thus it is a most important and fundamental fact that the nervous system is, relatively speaking, far more highly developed and plays a far greater part in the dog than in the ox or bull, for example.

The brain, the spinal marrow, and a number of sense organs, particularly that of smell, are paramously developed in the dog. A ten times larger proportion of the whole forces of the system is spent on the nervous system and the senses in the dog than in the bull. The functions of the sense of smell alone absorb immensely more of the formative forces of the dog than in most other animals.

Can it be said that sufficient emphasis has been laid on these facts in our study and descriptions of animal diseases? We think not. When we read the usual descriptions of symptoms for two such diseases as distemper and foot-and-mouth disease, for all the difference we can tell in the manner of description, it is as though these two diseases occurred in the same animal, instead of in different animals which are really poles apart. The dog is a creature of nerves and senses. Its digestive and metabolic system is not very much developed. The alimentary canal is only four and a half times the length of the trunk. The metabolism is lacking even in the function of perspiration. Instead of perspiration, the breathing serves to regulate the heat of the body. The dog pants instead of sweating. It replaces the metabolic system by the breathing, which in its centre of activity lies nearer to the system of nerves and senses, which serves the functions of consciousness, to a far higher degree. This basic fact explains all its qualities and expressions of life. The dog

too, is far cleverer and more skilful than an ox. A large proportion of the diseases of the dog are more of the nature of nervous diseases ; thus among others, the two most important—are, canine distemper and rabies.

The ox is paramountly a metabological animal. Its digestive system is extraordinarily highly developed. We need only consider the fact that in absolute magnitude the brain of the ox is smaller than that of a man, despite the tremendous bulk of its body. Nature has not spent much on the nerves-and-senses system of the ox. Moreover, it is a dull and unskilful animal. One never heard of an ox being trained to perform elaborate tricks. Altogether the ruminants are not very wide awake. The stupidity of the sheep is proverbial. But, on the other hand, the organism of the ox is truly inventive in the sphere of digestion. Its thoroughness and elaborate character in this respect leaves nothing to be desired. The digestive organism of an ox is a real work of art. The alimentary canal is twenty-four times the length of the whole animal—a marvellously elaborate system of stomachs and intestinal convolutions. How insignificant is the brain of this animal compared to its immense stomachs. The human stomach is not very much larger than the human brain. The ox's brain, on the other hand, could be contained at least twenty times in its stomachs. The legs too, are relatively much developed—strong and massive—and not very mobile. The ox has hoofs and horns, that is to say, the forces which otherwise work in the system of nerves and senses—giving rise to the sensitive skin—the finely sensitive sense organs and a highly differentiated brain are here gathered together to produce a thickening of the corneal layer of the skin at six distinct places. We find more of the corneal layer here than in the whole body of other animals. In the dog we have the impression that the organism, though the system of nerves and senses, lives entirely with the outer world. Through smell alone, the dog lives more outside than within itself. It can detect the presence of its master at a great distance. In the ox the opposite is the case. The horns are like a zone of condensation, a hardening of the system of nerves and senses from which all finer forces radiate back and turn inwards. The whole force is spent on the digestion and metabolism. And the tremendous circulation of the blood is placed entirely at the disposal of the digestive function. When an ox, grazing in a field, stares bluntly and reproachfully at the passer-by, as though he were some disturber of the peace, is it not as though the animal would say : whatever more do you expect of me than that I should be digesting and still digesting?

The ox is completely absorbed in the intestinal system, as the dog is in the sense of smell ; the one is an animal of digestion, the other of nerves and senses, so great is the difference between them.

When we regard the two animal organizations in this way, and acquire a real feeling of their contrast, we are quite differently prepared for a comparative study of the animal diseases.

In canine distemper a preliminary stage, which points to a morbid affection of the system of nerves and senses, is followed by a universal reaction of the mucous membranes of the sense organs and the respiratory tract. Sometimes, too, it results

in a universal exanthema. In foot-and-mouth disease it is the feet that become affected; it is the point where the horny layer of the skin is, as it were, gathered together and concentrated, in the hoofs. Here, purulent blisters are formed. In this disease the formation of vesicles goes more in the direction of the immensely developed mouth. That is to say, the digestive portion of the head is affected rather than the respiratory tract—though, indeed, rhinitis does occur in the ox; and, conversely, in the dog the mouth becomes inflamed and salivation takes place. Moreover in the ox large vesicles arise rather than exanthema or eczema; and the inflammations are profuse, they are on a larger scale, more massive.

In the dog the danger of bronchitis and pneumonia is predominant, for here the breathing system plays a far greater part. In the ox the blood-circulatory symptoms are the most striking and the most dangerous.

Nerves-and-Senses system.—Centre in the head	}	More highly developed in the dog.
Breathing system.—Centre in the lungs		
Circulatory system.—Centre in the heart	}	More highly developed in the bull or ox.
Metabolic system.—Centre in the stomachs and intestines.		

The reactions in the metabolism of the ox easily pass on into the circulation. The intestinal and stomach symptoms are followed by the heart symptoms.

In the dog, on the other hand, the disease in the mucous membranes of the head, may easily be followed by morbid conditions in the breathing system—by bronchitis and pneumonia.

In both diseases there is a universal reaction of the metabolism in response to the isolation of the nervous system, only this reaction is modified according to the one-sided development of either animal.

Foot-and-mouth disease leads to an affection of the heart. This happens in the ox because in the animal the whole disease process is more inwardly congested. The inner part, the stomach and intestinal system, is far greater than it is in the dog. Hence the greater danger of the affection of the stomach, and above all of the heart. The rhythmic system is attacked at its very centre. In the ox the whole process takes place more downward and inward towards the mouth, belly, feet, and heart. In the dog it is more upward, towards the brain and lungs. In the dog with the more comprehensive brain system, there is eventually a destruction in the brain; multiple centres of disintegration of the brain, spasms and paralysis and other nervous symptoms. In the ox these symptoms are less in evidence, and in place of them we find the centres of disintegration in the heart.

But nature is consistent, and even in the greatest extremes, the common element emerges. Thus in foot-and-mouth disease we find in a rudimentary form the symptoms which are most evident and obvious in distemper. Friedberger and Fröhner in their textbook say: "Small vesicles may also be found in the paunch and the intestines and on the bodily covering as a whole, especially on the breast, on the belly, and even on the cornea." Paralysis, too, is not altogether absent. Here

and there we find a weakness of the hindquarters approaching paralysis, as in paralysis of parturition, just as we have the paralysis of the hindlegs in canine distemper. Moreover, when foot-and-mouth disease is malignant there are cases of death in which bronchitis and gangrenous pneumonia play a prominent part in addition to the heart symptoms. Conversely in the dog the heart is often affected. There are slight arrhythmic effects, and there is at least a certain palpitation. But the disturbance of the heart is never so far-reaching. Hence, too, the remedy must be differently applied in the two cases. For the dog it is given internally, and in severe cases of nervous distemper by subcutaneous injections. In the ox on the other hand, we must work directly upon the circulation by intravenous injection. We must, in accordance with the whole process in this animal, direct our attack from the very centre.

Eventually it proves that the two diseases, different as they are in external appearance, nevertheless represent essentially the same inner process. They only diverge so much on account of the difference between the two animals. A living study of animal nature enables us to discover this fundamental metamorphosis even in the characteristic morbid symptoms when we really familiarize ourselves with them. For this reason the same remedy has to be applied in the two cases.

To sum up: Foot-and-mouth disease is essentially the same illness in cattle as canine distemper in the dog.

Experiments and Tests

The first tests with the new remedy were made during the 1920-22 epidemic in Germany, especially in Württemberg and Bavaria. We carried out prophylactic as well as therapeutic tests. Unfortunately just at a time, when they had reached a promising stage, all these experiments had to be interrupted because the epidemic died out in our main sphere of work: Württemberg and Bavaria. We had no opportunity of continuing our tests on any extensive scale elsewhere.

Therapeutic Tests

We will try and give an idea of the gradual development of our experiments, which, beginning in a simple way, gradually led to a perfection of the method and a progressive improvement in our results.

I

Our first experiments were carried out on a herd of cattle very severely affected during the epidemic 1920. In this particular village the disease had appeared in its most malignant form, accompanied by the most serious heart symptoms. In many stables a large proportion of the cattle had fallen victims to the disease, and fresh cases of death were continually being reported. At that time we still had to test not only the proper dose, but also the method of applying the remedy. Thus, to begin with, we used subcutaneous injections to a very large extent, and it was only in the further course of the treatment that we had recourse to intravenous injection.

Summing up the results of the first series of experiments, in which 237 animals were injected between the 7th and 31st July, 1920, the following may be recorded.

In the days immediately before we began our treatment a large number of animals in this village had died of severe heart effects daily, and many herds had quite died out. During the following three weeks several stables in which the epidemic was already raging were treated by us, the animals being inoculated with our prepared coffee. These stables belonged to small farmers. The animals which had been under ordinary treatment since the disease began, were now inoculated with our remedy. Thenceforward, in the stables, which we were treating, far fewer fatal cases occurred. Previously, the effects of the disease had been no less than devastating, but of the 237 animals which we treated only 37 ended fatally, i.e., about 16%. Moreover, the composition of our injection fluid had not yet been sufficiently tested at that time; the mode of preparation had not reached its present stage of perfection, and we did many of the injections subcutaneously.

In individual cases we often observed almost hopeless subjects, with the severest heart symptoms, gradually improve, so that they were kept alive.

In a few stables which we had under treatment from the very first, the percentage was considerably better. For instance, in one of them with 21 head of cattle, only one ended fatally. There were similar results in other stables. Encouraged by these preliminary experiments we proceeded with a new series.

II

The next series, carried out in August 1920, on a Bavarian estate in Regensburg, are also to be regarded as preliminary tests. In some cases the animals were only received for treatment on the third or fourth day of the disease, when severe heart symptoms were already apparent. Moreover the preparation of the injection fluid, as mentioned above, was not yet quite perfect. Owing to the severity of the epidemic and the unfavourable conditions, in the one group of buildings where there were 68 head of cattle, 13-19% ended fatally. In these stables, in the very first phase of the epidemic before we had begun our treatment, 5 animals had already died through heart attack, so violent was the disease. In another larger stable the result was better; we had the animals under treatment from the very start, and of 124 only 12 died - 10%.

III

A few months later 122 head of cattle were treated therapeutically on the Guldesmühle estate, near Dischingen, in Württemberg. On other farms around, the epidemic, which was exceptionally severe in all that district, had appeared with the most pronounced heart symptoms, and there had been many cases of death. It began on the 11th October, 1920, and went on until about the 25th October taking its course very rapidly. In a large percentage of the animals the heart symptoms were most severe. In cases where these symptoms did not improve directly after the first injection, we injected several times - sometimes even nine or ten times. But as a general rule we gave only two injections, or three at most. Of the 122

cases 8 were fatal=7%. Five cows died of the severest heart symptoms, and one was slaughtered when the symptoms grew too dangerous. One ox fell down suddenly as it was running along. In short, it was evident that these cases were exceptionally severe. Subsequent experience showed that it is unfavourable to give the injections in too rapid succession, which we did in many of these cases. All things considered, the percentage of animals that died was very small.

The hoof symptoms were often very pronounced and were given the usual surgical and antiseptic treatment. They disappeared without after effect.

A very striking fact was this : the yield of milk, though to begin with, it was reduced by about half, rose again to the normal a fortnight after the outbreak of the epidemic, in very pleasing contrast to the shortage of milk which often lasts for months, as it did for instance, in the neighbourhood of this particular estate.

IV

On another occasion, in July 1921, we had the opportunity of treating a number of animals at Aixheim, a small country place in Württemberg. Throughout the village the epidemic was raging so malignantly as to extend to about thirty farms, and almost every day animals were dying. It was only in five farms that we were allowed to make our injections : of 35 animals which we treated there only 4=9% ended fatally. One of these, a cow, proved to have been badly tuberculous.

Further details of a few of these cases :

(a) *Cow Nr. 3 Stable Gratzwohl.*

14th July, 1921.—Yellow and white piebald, six years, well nourished, quite apathetic. Widespread severance of epithelium in the mouth ; heart rhythmical ; pulse 80 ; R. 36. 70 c.c. injected, reaction fairly strong. At 45 c.c. difficult breathing, at 60 c.c. strong retardation of pulse, at 70 c.c. severe dyspnoea, quivering.

15th July, 1921.—Pulse rhythmical ; strong salivation.

16th July, 1921.—Heart feebly palpitating ; pulse arrhythmic ; no appetite.

17th July, 1921.—Heart irregular, with a stop at every twentieth beat of the pulse. A second injection was given, 85 c.c. ; strong dyspnoea during injection. Distribution of warmth bad.

18th July, 1921.—Pulse beats complete ; small irregularity of heart ; slight hoof symptoms.

20th July, 1921.—Still slight irregularity of heart ; good appetite ; bodily warmth well distributed.

22nd July, 1921.—Heart beat completely rhythmical ; appetite good, fully cured.

(b) *Cow-calf Nr. 5 Stable Gratzwohl.*

Piebald, 2 years, 9 cwt., well nourished. Ill since 13th July, 1921.

14th July, 1921.—Heart strongly palpitating, temp. 105.6 ; R. 54 ; pulse 108 ; severe aphtous affection of the upper gums. Intravenous injection of 75 c.c. (at 40 c.c. pulse accelerated ; at 70 c.c. retarded). General condition bad ; eating nothing.

15th July, 1921.—Pulse 84; temp. 102.4; R. 24; heart beat feeble; hoof symptoms present; general condition far better.

17th July, 1921.—Pulse 72; temp. 102.2; R. 36. Heart slightly arrhythmic. Renewed injection of 115 c.c. (at 30 c.c. pulse accelerated; at 50 c.c. to 100 c.c. slow again; afterwards arrhythmic action; breathing not intense).

18th July, 1921.—Pulse 78; heart still feebly palpitating; considerable severance of epithelium in the mouth. Surgical treatment of hoofs.

19th July, 1921.—Pulse 84; rhythmic heart beat, normal. Aphtae healed; feeling well; general condition, good.

(c) *Cow-calf Nr. 7 Stable Gratwohl.*

Piebald, $\frac{1}{2}$ year old, weighing $2\frac{1}{2}$ cwt. Ill since 13th July, 1921.

14th July, 1921.—Temp. 103; pulse 90; R. 36; heart normal; whole mouth inflamed. Intravenous injection of 25 c.c. (arrhythmic action at once, then retardation; arrhythmic action grows more severe, the animal falls down and jumps up again at once).

15th July, 1921.—Temp. 104; pulse 90; general condition good.

16th July, 1921.—Temp. 103.6; pulse 90; heart arrhythmic; diastolic murmur; eating nothing.

17th July, 1921.—Temp. 102.7; pulse 84; heart arrhythmic; diastolic murmur; eating nothing. Intravenous injection of 85 c.c. No reaction takes place.

18th July, 1921.—Pulse becomes rhythmical again; appetite not yet normal.

19th July, 1921.—General condition normal.

22nd July, 1921.—Completely cured.

It will be seen from these cases how quickly the heart symptoms react to the injections and how quickly they then recede. Again and again we observed the quick return to the normal yields of milk.

These therapeutic tests unfortunately had to be interrupted, because in the places at our disposal the epidemic declined and ceased. But it is evident how the percentage of fatal cases was considerably reduced as the remedy and the conditions of its application were perfected. Taking the total number of the above mentioned cases of treatment, we find 633, 74 of which were fatal, i.e., 11 per cent. Omitting the first imperfect tests we find 5% fatal cases in the later experiments, though the epidemic was no less severe and malignant than before. The following table may serve to make this clear.

Statistics of the Therapeutic Tests

		<i>Treated</i>	<i>Fatal</i>	%
(1.)	Ohmenheim ...	237	37	17
(2.)	Regensburg (a) ...	61	13	20
	Regensburg (b) ...	124	12	10
(3.)	Spaichingen ...	22	2	9
(4.)	Dischingen ...	122	8	6
(5.)	Smaller tests ...	67	2	3
	Totals ...	633	74	11

It will be seen how the percentage went down in course of time as the remedy was gradually improved.

Prophylactic Tests

Obviously in the treatment of foot-and-mouth disease the very greatest significance will attach to a prophylactic method. With our remedy the point will be, that before the disease sets in, the animals should be made to undergo the above described shock which leads to a sudden change in the whole circulation. This results in a protection against the disease. The rhythmic system, and the connection between the nervous system and the metabolic system, which the rhythmic system brings about, are so strengthened that the isolation of the nervous system which occurs in foot-and-mouth disease is not able to take place.

In our prophylactic tests we began with one injection only, to see if this would give the necessary protective effect. The single injection however, proved insufficient; several injections are necessary for effective protection.

We will first describe two cases to explain the method and the effect :

(1.) *Dun Ox, 1 year old, No. 32*

Intravenous injection 100 c.c., 70 c.c., 30 c.c., on the 8th, 12th, 13th and 14th August, respectively. Reaction not very strong, very rapid breathing and slowing down of the pulse. 17th August, 1920 : The animal was placed in a diseased stable near Dischingen, surrounded by animals suffering very severely. It was infected by abrasion of the tongue and application of fresh infected matter. The animal was kept in this stable till 27th August : it remained well and lively, showed a normal temperature and healthy appetite throughout. No kind of symptoms appeared. The animal proved completely immune.

(2.) *Dun Ox, 1 year old, No. 33*

Intravenous injection, 150 c.c., 40 c.c., 70 c.c., 120 c.c. on the 9th, 12th, 13th and 14th August, 1920, respectively. Reactions moderate : retardation of pulse and quickening of breath each time. Frequently a slight arrhythmic beat of the heart. 17th August, 1920 : The animal was placed in a diseased stable near Dischingen, and infected as the former with fresh material on the tongue. It remained there until the 27th August. No rise in temperature ; healthy appetite ; remains completely well ; no vesicle nor any other symptoms of the disease.

That these cases were not due to an original immunity or one acquired independently of our preparation, is proved by the following : At the end of October 1920—two months therefore after they had remained well in spite of artificial infection—both of these animals had a slight attack of the disease during the epidemic which then broke out on the Gouldeesmühle Estate near Dischingen, described above. Both animals became feverish and a few aphtae were formed and quickly healed. Thus they had not been immune, previous to the treatment with our remedy. Moreover, the animals were young, and there was no doubt that they had not had the disease before. By the end of October 1920 the protection afforded by our treatment was no longer strong enough.

We add a third case :

(3.) *Dun Ox 3 to 4 years old, No. 17*

Five intravenous injections, on the 28th and 29th July, 16th August, 2nd and 7th September, 1920—30 c.c., 50 c.c., 60 c.c., 70 c.c. and 100 c.c., respectively. (During the first injection the pulse was irregular and breathing accelerated till 25 c.c. then racing pulse ; the animal fell down, but stood up again at once. The other injections gave a feebler, but still a sufficient reaction.) Directly after the last injection, the animal was placed in a diseased stable near Dischingen and remained there for three weeks—until the beginning of October. It was infected with fresh virus in the same way as the last two animals. During this whole time in the diseased stable no rise in temperature nor any other morbid symptoms were perceptible. Afterwards the animal was returned to the very stables in which from 11th to 29th October, 1920, the 122 animals fell ill. There, too, it remained perfectly well. In the case of this animal it could again be proved that it had never had foot-and-mouth disease before.

To improve and develop the protective inoculation still further we tried to arrive at regular periods for the successive injections. We took successive periods increasing in arithmetical progression. Thus we began with an interval of twice 24 hours followed by one of four times 24 hours and finally by one of six times 24 hours. We calculated that the inoculations would then not be following so quickly as to result in the one reaction weakening the other.

After careful investigation to prove that they had never had the disease and were certainly not immune, three animals were purchased and treated with four successive injections at these intervals. They were the following animals :

- (a.) Young cow, red and white, 1½ years old.
- (b.) Young ox, white blaze, 1½ years old.
- (c.) Bull calf, white with red head, spotted behind, 6 months old.

(a.) The previous injections gave the following reactions. The first time 30 c.c. were injected. At 25 c.c. pulse was accelerated, at 30 c.c. racing. After one minute pulse distinctly arrhythmic. The animal swayed about in the hindquarters. Severe coughing.

In the second injection the reaction was feebler, only the pulse was much retarded and the breathing accelerated. The third injection produced a stronger reaction once more, and the last gave a reaction of normal intensity.

(b.) Preliminary treatment produced the following reaction : During the first injection there was already a strong acceleration of the heart beat at 10 c.c. quickly followed by arrhythmic action. The animal fell down, stood up again quickly, and went on shivering badly for a long time. The same process was repeated in the second injection. Even in the intervening time between the first and second and third injections it continued to have a palpitating heart beat, now and then slightly arrhythmic—a thing that never happened in other cases. During the third injection the animal swayed badly and nearly fell down. During the fourth there was again

a severely arrhythmic action of the heart. In the last interval, however, the continued disturbance of the heart beat had disappeared. It will be seen that the reaction was unusually strong in this case.

(c.) The first injection gave a strongly accelerated heart beat already at 10 c.c. At 20 c.c., intensely arrhythmic action was observed. The animal swayed badly and the hindquarters seemed almost paralysed. (It is interesting to observe how, in the reaction artificially induced by the preparation, all the symptoms which otherwise occur in very severe cases of foot-and-mouth disease seemed to be gathered together in one moment.)

In the second injection the same symptoms were repeated. In the third the heart beat was much accelerated after 10 c.c. but at 20 c.c. it was suddenly and intensely retarded. A minute after the reaction ceased, strongly arrhythmic action began. This was followed by an intense quickening of the breath and distension. In the third injection 150 c.c. were given, the animal only swayed and quivered slightly.

This preliminary treatment lasted from the 8th to the 28th February, 1921. At this conclusion the three animals were placed in a diseased stable near Dischingen. They were infected as follows: In each case the inner cavity of the mouth of a badly diseased animal was thoroughly wiped with a handful of hay and the hay saturated with the infected saliva was then eaten by the animal undergoing the test. This process was repeated a second time.

The course of the epidemic was severe in this and the neighbouring stables. From the 2nd to the 5th March the appetite remained good in all three animals, there was no fever, and there were no symptoms in the mouth.

First animal:

6th March, 1921.—Temp. 104.2; a small vesicle on the gum opposite the right canine tooth. (The two other animals were still quite normal, showing no fever and no symptoms in the mouth.)

7th March, 1921.—Temp. 104 and 103.2; moderate appetite.

9th March, 1921.—Some salivation and still a few small aphtae at the edge of the gums and on the tongue.

10th March, 1921.—Feeding quite normal again; aphtae healed; no fever.

11th March, 1921.—Almost cured.

12th March, 1921.—Completely cured.

Second animal:

Not until the 10th March—i.e., a week after the infection did a slight fever arise.

10th March, 1921.—Temp. 102.6.

11th March, 1921.—Temp. 103.8; erosion on the upper gum about the size of a pea; appetite none the less good, and no salivation.

12th March, 1921.—Temp. 102.6. Aphtae gradually healing.

13th March, 1921.—Temp. 102; still healing.

16th March, 1921.—Completely cured.

Third animal :

Fever did not occur until the 11th March.

11th March, 1921.—Temp. 103.6 ; aphtae on the upper gum about the size of a pin head ; appetite completely normal ; no salivation.

12th March, 1921.—Temp. 102.4 ; aphtae no larger and already healing.

13th March, 1921.—Appetite good, condition normal.

14th March, 1921.—The same.

The experiment on these three animals shows that in spite of prophylactic treatment a very slight illness was produced by infection. Nevertheless, the slight symptoms, the fever of short duration, the appetite which in two of the animals was not at all diminished (it is well known that in other cases the appetite is the first thing to disappear in foot-and-mouth disease) were out of all proportion to the severe illness of the animals surrounding these test cases, from which the infection was taken. Indeed, in the last animal it would have been possible to overlook the slight symptoms of the disease, if we had not carried out very exact observations, registering the temperature in each case and accurately inspecting the mouth symptoms. The prolongation of the incubatory period to eight days and the exceedingly slight, almost imperceptible appearance of the symptoms is especially remarkable. So far as we know, similar results have never yet been attained with any vegetable preparation, or indeed with any preparation other than a serum, in the prophylactic treatment of foot-and-mouth disease.

There is one more instance among our prophylactic tests which we would like to mention in conclusion.

Among the test animals which were purchased under special precautions as above, there were three more which we treated in a similar way. These were young oxen about one year old.

The reactions were rather less than the above described, but still quite satisfactory. To avoid repetitions we can dispense with an exact description of the reactions. In this case, however, we had chosen different intervals between the injections, namely 36 hours, and three times 36 hours, and five times 36 hours. The reason is, that after 24 hours there is frequently no reaction, because the animal has grown accustomed to the effect of the preparation. We have indeed maintained these last intervals as a general rule and we recommend them for further experiments.

The animals were infected in a diseased stable in like manner as before. This was done on the 17th April. In this case it was not until the ninth day that any sign of the disease occurred. On the 25th April minute aphtae appeared ; the appetite was lessened for a short time only ; salivation quickly ceased. In a word, here too, the symptoms were very slight. The prolongation of the incubatory period seems especially important.

In other cases we endeavoured to treat animals prophylactically a very short time before the illness appeared, not knowing that the animals were already infected.

Here the treatment was really a therapeutic one, applied at a very early stage of the disease. Here too it proved to have an extremely favourable and moderating effect on the course of the disease.

Promising as they were, our prophylactic tests, in which the animals that had undergone preventive treatment were placed in diseased stables, had to be interrupted. We are confident that research workers and veterinary practitioners interested in our treatment will co-operate with us in undertaking fresh tests and that the result will be further improved when this is done. Probably it will be possible to avoid the appearance even of the slightest symptoms above described. Indeed, this possibility was already realized in the three instances of prophylactic treatment just given above. It may be that it will even be possible to reduce the number of injections, but for the present we do not feel able to recommend a smaller number of injections than the above for prophylactic treatment, and we think also that the 36 hours intervals which we recognized to be the most effective are to be recommended for future use. We hope our tests will provide the starting point for many others.

Brief instructions for treatment with our preparations against Foot-and-Mouth Disease

We will now briefly sum up the results of these experiments in so far as the method of therapeutic and prophylactic treatment is concerned, in order that the mode of application may be perfectly clear.

(a.) **Therapeutic treatment.**—Intravenous injections should be undertaken as early as possible after the disease has broken out. Inject with a graduated irrigator of at least 100 c.c. The liquid preparation is warmed to blood heat and poured from the sterilized and then opened ampoule into the irrigator. The latter is then closed by a ground-in stopper in the form of a glass rod, which may at the same time be the thermometer. A fairly long rubber tube with a tab or clip and an attachment for injection needles is fixed to the end of the irrigator.

The veterinary surgeon should now introduce the needle into the vein of the neck under compression, till the blood flows out in a thin stream. Thereupon the needle is connected with the rubber tube and the glass rod removed from the irrigator. It will be good if at least the head of the animal is held by an attendant, in order that the glass instrument may not be broken by a sudden movement. The fluid is now poured in as soon as the doctor is ready to listen to the heart. The best rate is about 5 c.c. to a second, it can be regulated by raising and lowering the irrigator.

The doctor should auscultate while the fluid is being poured in. On the average, in the majority of cases, the following reaction will occur.

Acceleration of pulse, then after a time increasing retardation. The pulse grows fuller and stronger, till at a certain point the heart becomes arrhythmic. At the same time the eye of the animal grows dim and has a staring expression. There is a lowering of consciousness and often considerable swaying especially in the hind-quarters. At this stage one should stop and not let the animal actually fall down.

At the same time there is always more or less acceleration of respiration. If the animal coughs and groans and the breathing is too loud to enable the heart to be heard distinctly in the later phase of the reaction, one should either cease the injection or rely on the other symptoms, such as the swaying, the changes about the eye, and the general impression conveyed by the animal. This will be easy when one has acquired a certain amount of experience.

If arrhythmic symptoms of the heart were present already, the reaction as a whole is still distinctly recognizable as it takes its course. Moreover as a general rule the original irregularity disappears while the fluid is being injected.

The therapeutic inoculation may be repeated two days after at an interval of not less than 36 hours if possible. A third injection may be desirable if the condition has not improved or deteriorated. More than three injections will only be given in exceptional cases.

The **internal use** of the remedy is important especially for the gastro-intestinal symptoms. Particularly in young animals we often find the belly distended, borborygmi ceasing, and constipation setting in. A dose of 100 c.c. per oz. given straight from the bottle often produces a great relief in these cases and an animal which has been completely prostrated will recover very quickly.

When the gastro-intestinal disease is severe and gives rise to diarrhoea, the evacuations frequently containing blood, it is also beneficial to administer the remedy per oz in addition to the injection, though it need not be simultaneously. The dose can be repeated on the next day; and if the condition of the animal seems to make it advisable, it can even be given twice a day.

Prophylactic Treatment

The prophylactic treatment consists in several three to four intravenous injections.

It has proved advisable to give the injections at certain intervals, namely, if possible, an interval of 36 hours between the first and second injection, four and a half days between the second and third, and seven and a half days between the third and fourth, making fourteen days in all.

For the rest, the injections are carried out in the same way as described above for the therapeutical treatment. Such inoculations afford a protection for several months, and there is reason to expect that when the method is perfected this period will be extended.

Microscopic Tests

It would be incomplete, if we did not at least mention, that all our experiments with cattle were also accompanied by blood tests. We studied the blood of hundreds of healthy cows and diseased cattle and of course also the blood of those which had been treated therapeutically or prophylactically with our remedy for foot-and-mouth disease. It was a very interesting study indeed. In the diseased cows we found a severe destruction in the red blood corpuscles, but what interested us most,

was the great amount of " blood platelets." This element which we find in human blood as well, is described in many different ways. Some scientists believe that the platelets are part of the megaloblasts (i.e., an erythroblast or primitive red blood corpuscle of large size, found in the blood in pernicious anaemia and predominant type of nucleated red cells in the bone marrow of patients with pernicious anaemia during relapse), this is the theory of Wright ; others think they are the last physiological remains of the nuclei of young red blood corpuscles (theory Schilling). " The platelet's nature and physiologic role are still obscure, but they probably play a role in the clotting of blood." This statement we find for instance, in the excellent *American Illustrated Medical Dictionary* (Philadelphia and London, W. B. Saunders Company, 1941). Very often we found in the blood of the diseased cows and especially after the injections with our remedy these elements. They have the form of round or oval discs containing in the middle one or more purple granules. The disc itself is colourless, transparent. The outside membrane absorbs the red colour out of the "Giemsa" solution, which is especially recommendable for dyeing these elements of the blood. We find various types of platelets in human or animal blood. Some have not at all the above described clear hyaline disc, they seem to consist mainly of purple granules, some may still show a surrounding red circle, some seem to have split the membrane and clot together as amorphous heaps of granules, or we find only free granules. As mentioned before, there are many divergent opinions about the character of blood platelets in science and somehow we found it quite impossible to think that these well-defined corpuscles could be part of the nucleus of a red blood corpuscle, or part of some megaloblast of the bone marrow. Since we found such an enormous amount of clear, hyaline elements, with only one tiny purple grain in the centre especially in those tests taken immediately after the injection with our remedy for foot-and-mouth disease, we took the opportunity to ask Dr. Steiner about these strange elements. Dr. Steiner looked at the tests with great interest and gave the following explanation : " These corpuscles are a hormone of the spleen. They might be called **regulators**. The spleen is an organ which has the task of regulating the rhythm of the metabolic system. You can also find these elements in the human blood. For instance, if you would undertake to disturb the rhythm of the metabolic system, then you will find those ' regulators ' in the blood. Ask somebody to have instead of three meals a day, five meals ; and the following day only two meals and again the following day perhaps seven meals. It must not be much. But always when food is taken, the spleen has to balance the rhythm in the metabolic system. If there is a disturbance arranged so that you have more meals on one day and less another day, and again more on a third day : then you will find that hormone of the spleen in the blood."

We found this explanation of great importance, because since the oldest times the spleen has been considered to be a " mysterii plenum organon." Nobody knows why it is necessary for us to have a spleen. The spleen may be removed entirely and no function of the organism seems to be disturbed. In antiquity it was even customary to remove the spleen from those people who were carrying messages, the " courriers." Everyone knows, if we run too fast or too long, then we begin at

first to pant, and afterwards we get pains in the left side—the spleen begins to ache. Well, then, if the spleen has nothing specific to do, and only causes pain if one has to run—take it out.

That is the second task of balancing which the spleen has to fulfil in the **rhythm of the respiratory system**. We can only stand a certain amount of disturbance in the respiratory system—at first we try to make up for it by panting, then the spleen is asked to do more than this organ can stand and we feel the pain in our left side. This should of course be considered as a signal of danger—we should cease to run—and not be so absurd as to remove the warning organ from our organism.

Much could be said about this interesting problem, but we must limit ourselves here, and only mention that we studied this object thoroughly. About thirty people were good enough to help with these researches. They received detailed prescriptions for their meals. Of course we made a blood test before starting the experiment, and only those were suitable to undergo the test who did not show the “regulators” in their blood beforehand. E.g., if somebody leads an irregular life, just eats when he feels an inclination to do so, then he has already a disturbed rhythm in his metabolic system. Such a person has at first to be treated with regular meals for some time—at least a week. Then the blood is free from “regulators.” We can again cause an interference—and the “regulators” appear. It is a highly interesting study; now we are able, by making a simple blood test, to diagnose if the metabolism is in perfect rhythm, or if there is a disturbance. These experiments were published as the first work from the Biological Institute at the Goetheanum in 1922.*

Another very important point is that those “regulators” may be found in the human blood also, if there is no irregularity with regard to meals. It is possible to find somebody who really adheres strictly to meal times and never has more than three meals a day at the fixed hours, and yet has “regulators.” In this case we found that such persons always drink excessive quantities of strong coffee.

When we injected our special coffee preparation into the diseased cows, we described how the breathing is affected during the injection, the cows begin to pant—the remedy affects the rhythm of the respiratory system; then defaecation takes place during the injection, or immediately afterwards—the metabolic system has been affected—and in the blood we find the “regulators.”

We stated (see page 356) that the function of a remedy for foot-and-mouth disease is to repair the disturbed rhythm and to re-unite the upper and lower systems. Coffee has this capacity in the highest degree if it is prepared correctly.

* L. Kolisko, *Milzfunktion und Plättchenfrage*, 1922, Stuttgart.

Part Four.

WHERE DO WE STAND TO-DAY?
OUR TASKS FOR TOMORROW

WHERE DO WE STAND TO-DAY?

Again and again this question is raised: what is the present situation in agriculture? Book after book is written and in every book we find the same statement, that agriculture to-day is in a great danger. We need only look at one of the many magazines dealing with this subject. I have before my eyes a number of the well known "Farmers Weekly" Spring 1941. The front page bears the advertisement of a chemist advising the use of remedies:

Braxy and Blackleg Vaccine
Marsan and Malagride for Blackhead of Turkeys
Fowl Pox Vaccine
Lamb Dysentery Vaccine
Louping Ill Vaccine
Swine Erysipelas Serum
Lamb Dysentery Serum
Pulpy Kidney Disease Serum

Then we open the magazine and find another advertisement:

Oxygas versus Mastitis

and the next page shows a remedy for:

Liver disease in poultry and Turkeys.

then a list of remedies for:

Lambing and Calving Troubles.

We proceed and find a full page showing beautiful ears of wheat, potatoes, mangolds, sugar beet, and kale - of course they all have been treated with fertilizers and we are told: "Every acre must be dressed for greater yields. We must have heavier crops from arable and grass to feed man and beast. Increased output is easy to get and it pays! Dress all your land with Sulphate of Ammonia."

Another huge advertisement advises us to grow mangolds without potash. We have to broadcast 3-5 cwt. agricultural salt per acre, before sowing apply nitrogen and phosphate, and after singling to topdress with nitrogen. If we do all this, we are promised we shall get 4-8 tons roots per acre.

Again a few pages later, there is an article about:

More Foot and Mouth Disease.

Pedigree Herd destroyed.

It is calculated that about 1,000 and 1,500 animals have had to be destroyed, including a pedigree herd of Hereford cattle at Brinsop Court, near Weobley.

You may take other magazines for farmers and gardeners and you will get the same impression: there must be many diseases in cattle, sheep, turkeys,

-swine, etc., according to the many remedies. Cattle must be destroyed that disease does not spread. We must increase our crops, and can do this with the help of mineral salts.

More and more the soil becomes mineralised, and more and more diseases are created, and more and more remedies are invented for these diseases.

Hydroponics

Science goes on inventing new methods and so we have the next step: we abandon the soil completely, and begin to grow vegetables in water only.

This latest blessing of science comes from Dr. W. F. Gerike, of the Agricultural Department of the University of California. Sometimes we find other names for this method: **Chemi-culture**, or **Aquaculture**. The fact that plants can be grown without soil is well known, but it was only applied for experimental purposes in laboratories. We are well acquainted with this method and have used it for many years in our own experiments connected with the study of "smallest entities." Now it is suggested that we should use this method in practical farming or gardening. In California Dr. Kolisko saw Tomatoes cultivated only in water, growing to an amazing height, so that the fruit had to be collected with the help of a ladder. Dr. Gerike got an average crop of 120 tons of tomatoes from 8,000 plants grown in **sawdust** and **water** on a third of an acre under glass. He also grows potatoes and flowers successfully. Harold J. Shepstone, F.R.G.S., mentions in his article "Gardening without Soil"* that the requirements of plant growth are:

"Light, air, water, mineral salts and a support for the root processes. Soil is nature's expedient for providing the last three essentials (water, mineral salts and support for the roots) and it is by no means an ideal medium, subject as it is to such detriments as drought and flood and garden pests and weeds."

That is a very strange way to look upon the soil. In all the interesting explanations the main thing is never mentioned: **Life**. The soil means only: **mechanical support** for the root processes, and it provides water and mineral salts. If one has this conviction, then of course it is possible to introduce water culture. The advantage of this new method should be: "better health of the plants, quicker growth, a more consistent yield, less labour, lower growing costs and reduced space requirements."

"The seeds, cuttings or plants may be sown in sand, sawdust or cinders. If cinders are used, they should be first carefully washed out, so that all the fine material is removed. The nutrient solution should be given to the plants daily. Many methods for keeping the chemical solution continually percolating through the cinders have been devised and some experimenters have fixed up a vessel above the level of the pot so that the liquid drains through all the time. The liquid can be used repeatedly, so that, when it is drained off, it can be poured again over the cinders."

* *Meenno Magazine*, July, 1940.

" For those who prefer waterculture, a tank and special trays are necessary. The tank may be of many materials, shapes and sizes, but if metal is used it should be painted to avoid chemical action. For tomatoes the tank should be about 4 inches deep, for potatoes 8 inches. The tank should have 4 trays resting on battens just above the water level. The floor of the trays should consist of wire netting covered with a thin layer of wood wool, which in turn is covered with sawdust. The seeds are sown in the sawdust, or young plants set in it. The sawdust is kept moist by the nutrient solution in the tank. The tank must be aerated either by using an aeration pump, or small tanks are sufficiently aerated by paddling the solution each day for a few minutes. If the nutrient solution is heated, quicker crops can be obtained."

The nutrient mixtures can be bought ready for use. Harold Shepstone gives one general recipe which may be used with good results. To one gallon of water add one teaspoonful of saltpetre, one of Epsom salt, two of baking powder (free of alum) one to four of washing ammonia.

Is it not a pleasant idea? You need not have a garden, and yet you may grow your own vegetables, for instance on your roof garden in town! But do you really think that these plants produced with the help of saltpetre, Epsom salt, baking powder and ammonia will nourish you? What about the food value of these vegetables? Just let us think for a moment, that the tiny seed of a tomato for instance, representing concentrated life, is taken from nature, placed on a tray, and nourished according to our scientific principles with different salts; the roots are allowed to grow into the liquid instead of into mother earth and the plant will be supported mechanically. The seed is even so powerful that it really yields a well developed tomato. But what about the seeds produced by such an unnaturally grown tomato? The liquid mediates the forces of the moon, the light conveys the forces of the sun, the air is provided artificially by means of a pump, but all the other ingredients of a living soil, the manifoldness of life is missing. The earth is like a mirror receiving all the cosmic influences streaming in through the whole universe, and the plants reflect them in their growing processes. We up-root the plants, take them from their natural environments, and ask them to grow without soil. The seeds, if we look at them properly, are miraculous centres of life. **We have no power whatsoever to produce a seed artificially; the whole universe takes part in the production of the tiniest one. Man can only sow the seeds.** Why do we call the earth quite naturally " Mother Earth " ? Because instinctively we have the feeling that the seeds are received from the earth as from a mother's womb, cared for by nature's forces. We have to care for the soil, to bring life into the soil, and the soil takes care of the seeds we put into it.

In laboratory experiments it is permissible to use liquids only for studying the influence of certain substances on certain plants. But even then we must always bear in mind that we do something unnatural, and must repeat the experiments in the open to see how nature reacts to our treatment.

Looking back on all our experiments and studies we can only come to the conclusion that aquaculture, introduced on a large scale is not to be recommended for growing food. It represents the climax of our endeavours to use artificial fertilizers, and in the long run it must produce unhealthy plants, lacking in food value.

We suggest making experiments raising some generations of tomatoes, potatoes, beans and peas, always using the seeds produced through aquaculture. We are sure that seed deterioration will set in. There would also be the possibility of studying the life-forces of different crops by means of our Capillary Dynamolysis (See Part II, Chapter VI).

Our Daily Bread

Our daily bread no longer nourishes us. There is a difference between whole meal bread and ordinary white bread. This looks very appetising, it is perfectly white, and you can eat a whole loaf without feeling satisfied. The time is long past when one slice of farm bread was really enough for a hungry child! To-day we must even add a vitamin to the bread. We quote an article in the "Daily Express" July 20th, 1940:

"Looks like Sugar tastes like Acid--your war-Loaf Vitamin.

Secrets of Vitamin B₁, the new health safeguard which is to be added to Britain's war loaf, were revealed to me to-day by Prof. A. R. Todd, 6 ft. 3 ins. Scotsman, under whose leadership the vitamin was isolated.

With rice as his material, Professor Todd worked for nearly three years to find out how this nerve-building vitamin, found in vegetables, liver, and wholemeal bread, could be made synthetically.

The vitamin is now ready to be put into bread.

It is a white substance that looks like salt or soft sugar. I tasted some with the moistened end of my finger.

"That's enough for one person for a week," said Professor Todd. **You won't taste it.** It is chemically sharp and acid to the tongue. But the tiny quantity you will find in your bread will be odourless and tasteless."

"Enough to cover a sixpence would last you three months. An ounce properly apportioned would be enough for your whole life--giving you to the age of seventy-five.

Some vitamins taken to excess are poisonous. But not B₁. The body will just take as much as it wants, then discard the rest.

The B group of vitamins was discovered during research into the causes of Beri-Beri, a disease found in Eastern Asia and other places where rice is the staple food.

It was found that the rice, robbed of its husk and then polished lacked something necessary for the nervous system. The germ of the rice, the tiny tip of the seed, contained the vital vitamin."

Reading this article we must ask **what has been taken from the wheat, that the bread needs the addition of a vitamin ?**

Is it not strange, that we first rob the wheat of its nourishing qualities, and then must take a synthetic vitamin produced from rice to restore its vitality ? Why has the bread lost its living quality ?

We will take the answer to this question from another publication. In 1931 a book was published in Germany by Curt Leuzner* "**Poison in Our Food.**" It is a very valuable book, from which we quote the following passages :

Flour

"The nutritive materials of corn: The centre of the corn consists of the meal-body, containing the starch grains in the cells. 68·67% of this meal body contains pure starch, pure flour, the rest is water, some fat, some albumen, some mineral salts and **no vitamins**. The meal body is therefore a quite good, but in itself dead nourishment. Exclusive use of it becomes fatal, due to the lack of vital substances.

The meal body is surrounded by 8 different layers of raw-fibres, the cellulose of the corn. The inner layer, the gluten or aleuron layer and the germ are the bearer of nearly all the vitamins. Furthermore here is stored the albumen and the fat. The germ contains about 41% of the total albumen of the corn. In the other layers we find phosphoric compounds (40—50%) potassium, sodium, calcium (6%), silica, chlorine, iron and much magnesium.

The milling process : Knowing the above mentioned facts, one would think that people would take special care of these most nutritive parts of their daily nourishment. Nevertheless, we find that these valuable layers and the germ which represent the motor of the corn and are the life bearers for its consumer, are isolated in the mills from the meal body, to be used as feeding stuff for animals. How is such a fundamental mistake possible in our century which is so clever ? Why does the intellectually, highly cultivated, modern man carelessly cast aside the most precious thing Mother Earth and the Sun forces have built up for him ? Why does he commit suicide ? Business interests : the main reason is the great advantage the mills get in selling the mill by-products as feeding stuffs. That advantage is so great, that the finest flour can be sold more cheaply than the whole-meal. The isolation of these vital substances is justified because the fibrous substances are difficult to digest and because the fat content makes it impossible to store flour for a long time.

Wheat is the most milled-out product. Everybody likes to eat white bread, white pastry, macaroni, etc. The exclusive use of this natural product that has been milled to death, is a great danger to human health. We realise this in noting some involuntary experiments with nourishment. During the construction of the

* Curt Leuzner: *Gift in der Nahrung (Poison in the Food)*, Leipzig, Verlag der Dyk'schen Buchhandlung 1931.

Madeira—Mamore railway in Brazil 4,000 labourers died because their one sided nourishment was lacking in vitamins and produced acidity: white bread and Harque-fried meat.

During the war the battle cruiser "Kronprinz Wilhelm" had to enter an American Harbour because the food they got in capturing ships, fine white bread, biscuits, cakes, coffee, and tinned vegetables made the crew sick.

The German prisoners of war in Russia, working on the construction of the Murman Railway, suffered the same fate. Their food was lacking in Vitamin C and many died from Scurvy.

It is not unlikely that, owing to the enormous amount of white bread consumed even taking into account the apparent variation in our daily food, typical deficiency diseases will arise, especially scurvy. All this is very well known, and the scientists are endeavouring feverishly to find something which may balance that lack of vitamins, some additional substance which will restore to the flour what has been taken from it. Such an addition has been found. It is called: "Eviunis" and is said to be a freed phosphorous-vitamin-complex of the green plant. "The food industry is looking more and more to the production of "Eviunis" foods. To "eviunize" flour and pastries is very important, because the vitamin content of white flour and bread is very low, because the vitaminous parts of the corn fall into the bran." ("Der Zuckerbäcker" 34. Jahrg. 46/3). Here again we have something artificial. Instead of using the whole corn with all the layers containing the vitamins and mineral salts we add to the flour that has been milled to death, a mineral-vitamin-preparation, which is again produced artificially."

This book was written in 1931 in Germany and in 1941 the same problem is faced in England. The same mistakes are still going on, the same excuses are made. Why?—Business interests.

Powdered Meat will save Shipping space

This article was found in another daily paper on the 11th of July, 1941.
"May be produced by Australia.

Sydney. A process for reducing beef to concentrated powder form has been demonstrated in Australia. This may be the answer to Britain's meat shortage should this war be protracted, declared Mr. J. B. Cramsie, former Chairman of the Australian Meat Council. He produced a tin of powdered meat manufactured more than 6 years previously, to illustrate the success of the experiment. The meat was in perfect condition.

"In this form" he stated, "meat could be shipped by ordinary freight steamer or flying boat. It does not need refrigeration and would take up a fraction of the space which its own food value in carcase meat would occupy."

That is another threat to the health of mankind. Fresh meat is a living substance. What is powdered meat? It has been kept in a tin for 6 years. That is a marvellous experiment. But why was it possible to keep it intact for 6 years? Because there is no life in the powdered meat. The paper does not mention it, but perhaps some synthetic vitamin was added to the powdered meat after it had been killed.

A considerable scientific discovery: How straw can be transformed into cattle food. ("Picture Post" July 12th, 1941). This is also a very interesting article. We are told, "that three million gallons of milk are delivered on the national doorsteps every day. Two and a half million cows are employed to "manufacture" it." That the writer of the article uses the word "manufacture" is a sign that he considers the cow a machine and this impression becomes even stronger if we read the next sentence. "The raw material which the cows convert into milk is, in summer, fresh meadow grass in winter chiefly hay, roots (such as mangolds) and concentrated feeding stuffs such as cakes and meals."

"In the summer months, fresh meadow grass is alone sufficient to keep a cow content, and to enable her to produce an average of 2 gallons of milk a day. In the winter months, roots and hay are sufficient to maintain a cow in health, but not sufficient to draw off any appreciable quantity of milk from her. To produce milk, at a time of year **when nature never intended the cow to give it**, the animal must have $3\frac{1}{2}$ lbs of concentrates (or their equivalent) for every extra gallon of milk she gives.

If a cow can't have her cake, she can't deliver any milk. This winter there will be little or no cake (because cattle cake is an imported product and imports of the stuff have virtually ceased.) Unless the farmers can find a substitute, there will be no milk this winter." . . .

"To use our reserves of grass in the form of hay, silage and dried grass as economically as possible, scientists have been studying ways of making animal feed out of waste products. Now the research station at Jealot's Hill announced that it has perfected a simple way of converting straw into palatable feed. Hitherto, straw—with the exception of oat-straw—has been used only as litter because, in its natural form, cattle are unable to digest it. The scientists at Jealot's Hill have found out how to pre-digest straw, so that it becomes a palatable food. It is of such high food value that it can be used to replace all the roots, or part of the hay and corn in rations for milk production. Its advantage is that any farmer can make it. The news is still news to many farmers. By chopping straw, putting it in a weak solution of caustic soda, then washing it in running water, a soft and bright yellow pulp is produced which the cattle can eat and enjoy. How successful the new feed is depends to a large extent on how quickly the farmers adopt it."

Again we must say, as a scientific experiment it is quite interesting—but how it will turn out in practical life is very questionable. We grow further and further away from nature in our agricultural measures. Of course people may

support the opinion that during the war it is necessary to use extraordinary measures. But how much will it help, if we get milk from cows fed from straw treated with caustic soda so that it can be digested ; that milk will not and cannot be equal to milk from cows properly fed.

We introduce more and more unnatural methods and we shall have to pay very dearly for them. Years ago it was tried in human medicine to let people have pre-digested food. The outcome of this experiment was, that the whole digestive system was weakened. Now we begin to give cows pre-digested food. How will the whole metabolic system of the cow react after a certain time ? What new illness will appear ? What new remedy for it will the scientists have to invent ?

And will it not affect our children ? Milk is used for feeding children mainly, and if they do not get a really healthy product from a healthy cow, their digestive system will react. Of course science can go on and on inventing new artificial feeding stuffs, new artificial fertilizers, new remedies for animal diseases and plant pests— but mankind will have to pay an immense bill for this short-sightedness.

Having glanced through a few of the daily papers and magazines, we may as well have a glimpse in the shop windows. The druggist stores, the shops which sell agricultural implements and seeds, or plants, also sell fertilizers. Huge posters already catch our eyes from a distance : " Feed your crop with fertilizers ! " Each year we need new fertilizers as well as old ones. You may get them in packages for 3d. or 6d. or 1s. or more ; special fertilizers for flowers and vegetables, fertilizers which promise you results within " one week," others promise you the result in " 10 days," some say that they are " even more than a fertilizer," others say they have a " living fertilizer." There is a special fertilizer for carrots, another for potatoes, and another for tomatoes. Side by side with these attractive fertilizer packages you have packages containing remedies for " Potato Disease," " Tomato Disease," dry sprays and liquid sprays, Bordeaux powder for celery leaf spot, Apple and Pear Scab, brown rot of fruit, peach leaf curl, cherry leaf scorch, rose rust, all fungus diseases ; or preparations of Sulphur for mildews, white rust of spring cabbage, lettuce and tomato mildew for treating potatoes when storing and planting ; it is also good for use against the red spider, the onion fly, the carrot fly and turnip fly. Then you get tins or packages of " Weed killers," " Slug Killers " and so on. There are as many fertilizers and as many diseases with the special remedies as there are plants. Watch people standing before these windows or in the shops—how confused they are ! Everyone wants to do the best for his little garden or allotment and it is very difficult to find the way through all these advertisements. Yes—it really seems to be a big business. Perhaps the business which is done with fertilizers and sprays and remedies, is even bigger than the one which is done with the agricultural output ! I would not wonder.

Now let us study some recent publications. There is an interesting book about " **British Agriculture.** " The Principles of Future Policy. " It is a report

of an enquiry organised by Viscount Astor and B. Seebolm Rowntree." We have the "Penguin"—Edition 1939 and quote the following passage from the preface.

"Some have criticised us for not having dealt adequately in our earlier volume with what is called Bio-Dynamic Farming and the Indore Process or the importance of humus or organic manure. We have accordingly made a point of consulting some of the most representative and independent authorities on the subject. The claims by supporters of this school briefly appear to be, firstly that an essential condition for obtaining the best quality in food, is the treatment of the soil with organic manure, whilst the lack of such organic manure impoverishes the soil to such an extent that animals and human beings eating food grown on it suffer in health and physique; secondly that disease is increasing among human beings and that this increase is due to the larger use of artificial fertilizers, or to the irregular application, or to the non-application, of humus; and thirdly that the consumption of grain and legumes grown on soil treated with organic manure (compost or humus) produces an improvement in health and physique which is measurable and augments resistance to infection."

"Now, no one would deny the desirability of maintaining a proper organic content of the soil, and that humus certainly plays an important part in preserving this. But to admit this is far removed from accepting the statement, that human disease is increasing and that this is due to food having been grown in soil where artificial fertilizers have been used, or to food having been grown in soil where no natural manure had been applied."

"The evidence to substantiate these claims seems inadequate and certainly all the vital statistics seem to indicate that disease among human beings, far from increasing is decreasing. There is no doubt that crops grown in soil very deficient in certain minerals will become deficient in these constituents, and animals fed exclusively on these crops will in their turn become deficient and may become ill if these constituents are lacking. This is for instance, true for aphosphorosis in horses, cattle, sheep and goats, a disease known all over the world in animals living on crops deficient in phosphorus."

"Bad farming will obviously lead to a loss of fertility of the soil. But it has not yet been proved, that the use of "compost" necessarily denotes good farming or better quality food."

"Compost adds plant food, *e.g.*, lime, phosphorus, etc., and adds humus which helps to retain moisture. But any artificial means of supplying these nutrients in the form of inorganic substances might have the same effect upon plants as these nutrients supplied in the form of compost, and any kind of material which would help to retain moisture might have the same effect as the cellulose in the compost."

"Experiments have been carried out in Rothamsted in which wheat was grown in three plots of ground which had organic manure, chemical manure, and

no manure respectively. No difference in quality of the grain could be noted, though this does not necessarily mean, that the results would be the same if the experiments were carried out for a longer period."

"While, of course, there is much still unknown, there seems to be no evidence of any mysterious substances or quality in compost or humus which would affect the health value of plants other than nutrients which could be applied by the ordinary commercial fertilizers."

"It is to be hoped that some scientific body will study and report on the whole question of the use of humus and that, if necessary, further experiments will be carried out. Otherwise the case for a sound nutrition policy based on a balanced dietary, which includes a sufficient quantity of the protective foods, gets confused in the public mind with the question as to whether the quality of both protective and energy foods can be, and is being, seriously affected by the conditions under which they are grown to-day in most countries, including Great Britain."

Bio-Dynamic Farming means: Farming according to the suggestions of Rudolf Steiner. We do not find the name "Bio-Dynamic" a very good one, therefore it has not been used in this book. So many movements and remedies exist which have similar sounding names, that we have preferred to call the method quite simply by the name of its founder, **Rudolf Steiner**. We sincerely hope, that the ample scientific material we have given in Chapter XIII "Artificial Fertilizer"; Chapter XIV "Experiments with animals to study the influence of smallest entities"; Chapter XV "Nutrition"; Chapter XVI "Vitamins"; Chapter XVIII "Capillary Dynamolysis: a new method to study the quality of animal excretions as a guide to their value as manure," contained in Part II; and Chapters I-VIII in Part III will satisfy the demands of Viscount Astor and B. Seeborn Rowntree. We do not employ any "mysterious substances" in the making of our compost heaps and we can prove definitely that such compost or manure heaps may be considered as life-centres, increasing the fertility of soil—and that there is no life in the ordinary commercial fertilizers.

There are other interesting facts in the preface of the above-mentioned book. For instance the authors refuse to be satisfied with the public expenditure of the present "meagre £150,000 per annum on the partial investigation of animal diseases, when these cause to the nation an annual loss estimated at £19,000,000."

In the chapter "Improvement and Management of Grass," it is stated that many farmers still expect grass to grow by itself and do not see that a little money spent on fertilizers saves a bill for winter feeding-stuffs. Here we would like to point out, that especially for grass pastures, we will get the best results by using compost. We need not have animal manure for our pastures—nor should we use fertilizers. If we build up a heap of all kinds of garden refuse, fallen leaves, lawn mowings etc., in layers, alternatively sprinkled with quicklime, we must make sure that this heap does not smell. This would indicate that some of the nitrogen is escaping. We can avoid this by covering the heap with a thin layer of peat-moss. When the heap is sufficiently big, we insert the preparations (see

detailed explanations in Part III, Chapter IX). If we use such a compost for the pastures, cattle and sheep will like to eat the grass, and furthermore, we get a most excellent hay which retains the food value. It would really mean an improvement in the value of grasslands.

In the Chapter X about fruit growing, we are told that the most baffling problem in fruit growing is the control of diseases and pests. Disease is more serious than it was 30 years ago, and the only effective ways of combating these plagues are the production of healthy stock and spraying.

Chapter XIV mentions the problem of the poultry farmer, and how to minimize the rate of depreciation of his stock. Probably about 50% of the laying flocks are withdrawn every year. That gives a total life to the bird of 2 years or a laying life of $1\frac{1}{2}$ years. On top of this, between 10 and 20 per cent. of the birds die of disease. The Poultry Technical Committee in 1938 took a grave view of this aspect. They found poultry stocks riddled with debility and disease all over the country. They quote an authoritative estimate that the losses among adult birds alone cost the industry £4,000,000 per annum (equal to one fifth of the gross output of eggs). One of the obvious needs of the industry is to reduce diseases.

Chapter XV deals with milk production and gives some very frank statements. For instance it is stated, that the problem of the length of the life of the cow has received too little attention from farmers and agricultural economists. "The length of active, **healthy** herd life of the British milk cow is far too short. From investigations made by dairy research institutes milk recording societies and calculations based on our annual agricultural returns, the average herd life (*i.e.*, the period during which she is yielding milk) of the English cow is slightly shorter than that of the Scottish cow and probably three years shorter than the Irish cow. With a milking life of only four years, the ability of a herd to maintain itself is extremely doubtful."

Then the authors raise the question: What are the causes of this early mortality among cattle in England? They find, that "there is no very conclusive answer, but it seems probable that the demand for high yielding cows and the intensive system of milk production practised in this country are contributory factors owing to the strain imposed on the cows' constitution. Another disadvantage of this practice is that maximum yield does not necessarily mean maximum profit as, after a certain output has been reached, a cow's yield will not increase proportionately to the extra food given to her. The ideal which has been laid before farmers and encouraged by agricultural shows, feeding-stuffs manufacturers, and rearing and breeding societies—that of attaining the maximum yield per cow—is a false one, and it is therefore not surprising to find quite frequently the unorthodox farmer with "poor" stock, low yields, but still lower costs, making better profits, than the "superior" farmer with a high class stock and high yields. This is the experience of Wye Agricultural College, in their investigations in Kent. As long as the average yield throughout the Country

was very low, the ideal of a high milk yield provided a good rough guide to the improvement of cattle. But there are signs that this ideal has served its turn and may now become an actual handicap to improvement. It is likely that the future of the British dairy industry lies in the direction of low costs and long lives rather than in high yields and fancy breeds."

Then follow the investigations about **Disease** and we are told that the "wastage of dairy cows through disease (Tuberculosis, Abortion, Sterility, John's Disease, Mastitis, Foot and Mouth Disease) presents a very grave problem in the industry. This was revealed in striking fashion by special investigations made in Scotland (1929) Cambridge (1928-1930) Reading (1929) and six southern counties (1930) each investigation covering from 9,000 to 13,000 cows. The result showed that about 50% of all the cows were disposed of through some form of disease. Not more than 5% died of old age."

"Two of the most serious diseases are tuberculosis and contagious abortion. The Public Health Committee of the L.C.C. reported in 1933 that 83% of the milk arriving in London in glass tanks contained tubercle bacilli. The Economic Advisory Councils Committee on Cattle Disease estimated that 40% of our cows would react to the Tuberculin Test. There are about 5,000 cases each year of people suffering from bovine tuberculosis and about 2,000 to 3,000 deaths. (Journal of the Ministry of Agriculture 1932). This aspect of the question is of the greatest immediate importance, both to public health, and as inflicting a loss to farmers. Contagious abortion though less in the public eye is equally important, whilst "mastitis" (a generic term given to udder affections) may cause even greater losses to farmers.

The reasons for the diseased condition of the British dairy herds are not altogether clear.

Government measures for cleaning up the dairy herd have up to the present been inadequate.

The policy of slaughtering (with compensation) may have lessened the sale of highly infected animals but it has done little to eradicate disease."

Chapter XXII, Research, Education and Advice state that "**Science** and the **Machine** will gradually conquer the peasant, to his ultimate advantage and greatly to the advantage of the common man." We are afraid that we cannot share this opinion. We appreciate all that science has done for mankind's evolution—but should it happen that "science conquers the peasant," that means his natural instinct for the soil, his intimate knowledge of nature's own ways and should the machine become the **master instead of being the servant of man**, then it would happen that mankind would starve in the midst of plenty. We might have an enormous amount of each commodity—but worthless food that cannot nourish man or beast. This is our deepest conviction, so we must express it as strongly as ever we can.

Under the heading of "Agricultural Research in Britain" we learn that it took the British Farmer many decades to learn the value of artificial fertilizers: "but recently, partly owing to the low price of fertilizers, he has used them more liberally and the total consumption is now 35% higher than in 1913. But there is still the problem of efficiency of utilisation of fertilizers: effective use is made only of a small part of the fertilizer used; the remainder appears to be lost, entering neither into the soil nor the crops."

The breeding of cattle and animal nutrition is pointed out as another important line of research. The question of the causes and effects of malnutrition among animals is intimately associated with the quality of food stuffs; the food must come up to certain quality standards. But how can we expect to get that standard quality, if we bring more and more dead mineral fertilizer into the soil?

It is suggested that more and more machines—the tractor the gyrotiller, the combine harvester, the electric milking machine should be introduced in all branches of agriculture.

The chapter closes with the statement, that at the present time it is "plain that a great deal more work needs to be done on animal diseases. Among cattle alone the loss through disease costs farmers some £19,000,000 a year. Although this branch of research has been extended, far more will have to be spent in the investigation of disease and other problems connected with live stock. Practically the whole of British Agriculture depends on our live-stock industry; until the animals are healthy, farming will not be healthy either."

Here we must say it is just the opposite way round: **Until farming is healthy the animals will not be healthy either.**

Another interesting publication is the Penguin Special "Science in War." The title page assures us, that "this book not only analyses the conditions which have lead to this dangerous state of affairs, but also shows where science could be applied with immediate benefit to our national effort. It has been written by 25 scientists, all of whom speak with authority in their own fields."

We are of course specially interested in the chapter dealing with the agricultural problem, that is Chapter V: Food. At the beginning we are told about the importance of the vitamins. We are told (page 68) that it is "useful, though dangerous, to draw an analogy between the body and another form of internal combustion engine—say a motor car. The former is mainly built of water and protein; the latter mainly of metal. Both obtain energy from the combustion of fuel, petrol in the latter and foods (mainly carbohydrates and fats) in the case of the former. The body obviously relies largely on protein for growth and the replacement of wear and tear, just as the motor car needs mainly metal for its manufacture, we see that minute amounts of special metals are necessary for the manufacture of certain essential parts of the engine—for instance, the points of the magneto. In a similar way small amounts of vitamins and salts are necessary for specific functions of the body. . . ."

" Obviously the amount of foods required by a person depends on his size, his activity, and whether he is growing. The amount of petrol a motor car burns, depends upon its size and the work done by the engine ; when the latter is only " ticking over " it requires a little petrol, but much more is needed when it does work in moving the car. Similarly a resting soldier expends some energy, about 1,600 calories a day in keeping his body warm and his heart beating, but when he goes into battle he expends 4,000 calories. The amount of vitamins also depends upon the size and activity of the person, and active adults, pregnant or nursing women, and children need considerably more than sedentary people."

Then we are told (page 69) of the experiences made in the last war concerning food ; the importance of fresh fruit, lemons, oranges, etc. ; that vitamin shortage was the most important cause of the collapse of the home front in Germany in 1918. " The enemy no longer had any stomach for fight."

(Page 70). " After the war knowledge of nutrition increased at an enormous rate. Science told us what we should eat and why we should eat it, and also made cheap synthetic vitamins available."

(Page 72). The food problem becomes of outstanding importance and the cost and supply of vitamins and salts is an urgent problem." (Page 74). " Science has provided an emergency solution of this urgent problem. Nearly a dozen vitamins can now be manufactured artificially and it is possible to prepare some of them in large quantities and cheaply either by synthesis or by extracting them from rich sources that are not needed as foods. As an example of the former, a daily dose of pure vitamin B1 made chemically to-day costs a halfpenny (and the price could be reduced to a tenth of this if private commercial interests were controlled), whereas 6 years ago the cost of the yeast alone from which a daily dose of the vitamin could have been extracted was 10s. In other words, an amount of this very important vitamin that could now be obtained for 1d. cost over £10 six years ago. Other vitamins may be obtained more cheaply by extracting them from rich natural sources : the Russians are extracting vitamin C on a large scale from pine needles. The minimum daily requirements of each of the ten or so most important vitamins, together with a few important minerals (such as calcium, iron, a trace of copper) could easily be incorporated in a " biscuit " which would be distributed free or at a very low price to the whole population. The annual cost would be less than £2,000,000, and the saving in health and efficiency immeasurable. This figure of £2,000,000 should be contrasted with the vast sum (approximately £50,000,000) that is being spent in subsidising British Agriculture to an extent that is inadequate to provide these vitamins. If each person in this country who chose could get just sufficient of each of the most important vitamins by the simple expedient of eating a free biscuit daily, the chief part of the nutritional problem would be solved, both in time of peace and in time of war. This is only one of the gifts that nutritional science offers, and it is for the government to accept this gift."

That is one of the solutions offered by this scientist concerning the food problem. Furthermore he suggests (page 75) that home produced foods could be increased enormously by providing sufficient power for efficient cultivation, by the control of pests, by the scientific use of fertilizers, by making silage and grass drying, by using by-products (e.g., for growing yeast) or waste products (e.g., sea weed and nettles for turning into forage, and sewage for feeding fish ponds); and by the full use of chemical methods of preparing foods artificially (e.g., the treatment of straw with caustic soda for forage and the artificial production of sugar). "From these facts the important conclusion breaks forth: science can make us largely and perhaps entirely independent of imported food, and can also raise the health of the people from its level in peace time by providing proper nourishment. The government must mobilise science for this great triumph."

"We must produce much more. And to do that it is necessary not only to increase the amount of the land under cultivation, but more particularly to increase the yield per acre."

(Page 83). "During the first winter of war the only constructive effort to stimulate agricultural production was the ploughing-up campaign. The advice of scientific experts was neither sought nor encouraged. So far as agriculture was concerned, this was a non-scientific war."

(Page 83). "What had scientific research in agriculture to offer, in view of its neglect in this country in the years preceding the war? Admittedly far less than it might. There is, however, a large amount of scientific knowledge which is available and is at present not being used. Thus, existing experimental results indicate quite conclusively that much of our agricultural land is grossly under-fertilized. Moreover, experimental work has shown that on heavy soils the supposed virtues of farmyard manure are largely mythical, and that at any rate over a short term of years it can safely be replaced by artificial fertilizers. The maintenance of large heads of live-stock on such land merely to produce farmyard manure is certainly not necessary."

Then the scientist speaks about the different plant diseases, animal pests, etc. He advises (page 91) "that the biological societies which ordinarily meet to discuss individual and diverse problems, could be turned to practical use. They should meet together and with farmers, under Government auspices, to discuss urgent economic problems, such as those of insect control and to make proposals for dealing with them. The eager response to any such request from those whose names are now buried in the Central Register of Scientists would at once show what these men could do to help the country."

In the chapter "Meat at any price" (page 97) we are told, "that the ideal protein diet for a man would *a priori* seem to be meat from another man. As this is socially undesirable, the next best is to eat the flesh of another mammal such as an ox. Rather more ox must be eaten than appears necessary, in order to make sure that a man gets the correct sorts of amino-acids he needs from the rather unsuitable ox proteins. Still more meat from lower animals must be

eaten to supply these needs, and still more of proteins from plants. In fact to get the right amino-acids from plants it would be necessary to balance a vegetable diet in a very complex way. High grade meats are therefore a very desirable part of our diet." (Page 99). "The production of meat in a country depends upon the fertility or rate of growth of its farm animals. But these factors could be immensely increased by the application of knowledge that has been gained in the last twenty years about the physiology of reproduction and the process of growth. Every stage of reproduction and growth is under control of "hormones" which are specific chemical substances liberated into the blood by certain glands, and which control the development of other organs and tissues. In some cases they can be made synthetically and all of them can be extracted from parts of the animal body usually discarded in slaughter houses."

"We already know how to apply our knowledge of "hormones" to the problem of meat production. The first is the acceleration of the rate of production of the eggs from which the next generation will be formed. This is of no immediate interest in poultry farming, since egg-production has already reached very high levels in the usual laying breeds. A field of immediate application, however, is sheep breeding. Most of our breeds of sheep produce lambs only once a year. Some have as few as 20% of twins, others as many as 80%. One breed the Dorset Horn—lambs twice a year. These differences have developed, as we saw, under selection, and can be gradually overcome by selection. But for our immediate purposes the situation can be changed by direct treatment of the ewes to encourage twinning and to make them, if we want, breed twice a year (Medical Research Council Report 1938-1939. H.M. Stationery Office 1940). If an increased crop of lambs could be dealt with such a crop could be obtained by artificially induced fertility."

"So far as the growth of animals is concerned it is unfortunate that science cannot offer methods as certain as those which will accelerate their breeding. On the other hand, there is a mass of information about the hormonal factors which influence growth. The pituitary gland, the thyroid and the sex glands all play their part, and what is necessary now is to examine the many claims that have been made in this field and to determine what use can be made of the knowledge that is available."

"The production of milk is also under hormonal control and in the last few years research has been going on at several centres including the Dairy Research Institute at Reading, on the possibility of increasing yields, or prolonging the period of lactation, by administering hormones. Favourable results have been claimed for extracts both of pituitary and thyroid, and Russian scientists claim to have been able to effect increases of 20% in milk yield in this way."

"In every field of agriculture and husbandry, therefore we find that the application of scientific knowledge and scientific methods could immediately increase productivity."

Our opinion is, that this quite unnatural way of forcing the animal body to produce more generations, to have twins and in such a way to produce 4 times as many as the natural conditions would allow would mean: **exhausting the animal body in the same way as the soil is exhausted by fertilizers.**

Here science wants to use the "hormones," there the "fertilizer" to increase "crops of plants" or "crops of animals." The price will have to be paid for this misuse of nature—and it will be: **loss of fertility of the soil, loss of fertility in animals.** More diseases will arise, more abortions, less strength to withstand epidemics. **The vitality of the animals will be more and more weakened. We will have bigger crops without food-value, we will have more animals, without health.**

Another Penguin Special is the book "Our Food Problem and its relation to our national defences" by F. le Gros Clark & R. M. Titmuss. In this book we are told in the chapter about "Home Farming and War," that "the true danger is that of exhausting the fertility of the soil. Food is not produced **on** the land but **in** the land, since meat, milk, and eggs depend ultimately upon vegetable feeding-stuffs. The soil must therefore be kept in "good heart." All who have studied the problem agree to-day that arable-grass farming is the only safe method; every few years the pastures should be ploughed up and seasons of grain and fodder crops follow before fresh grass strains are sown. Otherwise the pasture itself deteriorates and the farmer, depending more and more upon imported feeding-stuffs, uses his fields as a mere exercise ground for his stock."

(Page 52. "The improvement of the soil is simply a matter of applied science. It has been estimated that at least 16,000,000 acres of grassland could be made to increase their fertility; by proper management of the grass, the stock-raising capacity of most pastures could be doubled. Even the rough hill grazing areas could be improved, at all events up to the height of 3,000 feet above sea level, by ridding the soil of existing vegetation, applying suitable fertilizers and sowing it with selected strains of grass and clover."

(Page 53). "We have already remarked on the illusion that we are increasing our food production. We have become more and more dependent upon imported feeding stuffs. The cattle, pigs, and poultry are machines—and wasteful machines at that—for converting imported grain and oil seeds into meat, milk and eggs. It is true that we must have meat and eggs in our diet; but the question is whether we should not save by importing them in time of war and saving our tonnage on feeding-stuffs."

Another recent publication is Lord Northburn's book "Look to the Land" (1940). Lord Northburn is a landowner in Kent and Northumberland, and runs a large mixed farm and market gardens. He says in the first chapter, that; "Few people realise as yet that the agricultural problem is by its very nature every bit as much a townsman's problem as it is a farmer's problem and that there is far more in it than a question of cheap and abundant supplies of food.

This book is an attempt by a layman, writing for laymen, to set forth how much more there is in it. It is an attempt at a biological and economic conception of the present situation. As such it must start from the soil."

He points out the danger of soil erosion, which is always going on, even on some soils which are in a good state of fertility, and refers to the large literature on the subject, especially to the well-known book "The Rape of the Earth" by Jacks and Whyte. No country is wholly exempt from this phenomenon, but the big continental areas are generally the most seriously affected. There is soil erosion in U.S.A.; in Africa, the Sahara Desert is moving at a mean rate of over half a mile a year, the Turkana Desert at six or seven miles a year. In China, in Russia, in Canada, everywhere the same tendencies are observable." "But serious erosion is only the culminating stage of a process of which the initial stage is usually loss of fertility of one kind or another. "Probably more soil has been lost since 1914 than in the whole previous history of the world."

Lord Northburn voices his opinion, that so far as the modern growth of deserts is concerned it is not nature, but man who is the desert-maker. "It is not unlikely that most of the great deserts of the world are of his making. When we consider how he sets about it now in conjunction with the fact that traces of high civilisations are found in many areas now desert, the probability of his past guilt becomes greater. And the exhaustion of the fertility of the soil is no new thing, nor is the temptation to practise it for the immediate gain. The new feature in the situation, is that man has recently enormously extended his physical powers by the use of mechanical devices. One man can now do what used to be the work of dozens or even hundreds, and can do it faster."

Having found out that farming is sick, Lord Northburn wants to look at man and domestic animals, to see if they are also sick. "If they too are sick there must be some suspicion of relationship between the two sicknesses; especially if the sickness of man and his animals is otherwise difficult to account for. But in considering man and animals we are up against a difficulty. It is this: how are sickness or health to be defined, or with what state, present or past, actual or hypothetical, is any present condition which may be found to be compared? Exact records of past states of health in any form which could be called scientific are not available, still less in conjunction with exact records of the biological environment accompanying them. In so far as we try to assess any improvement or deterioration of health over any considerable period, we can only rely on accumulated impressions. These may carry conviction, but do not constitute scientific proof. However, if we waited for scientific proof of every impression, before deciding to take any consequential action we might avoid a few mistakes, but we should also hardly ever decide to act at all. In practice, decisions about most things that really matter, have to be taken on impressions, or on intuition, otherwise they would be far too late. Even in the domain of science, where exact measurement is sacred, and exact evidence based on it is the aim (and a very good aim though a limited one), the important advances have been made

through intuition, politely called genius, and the scientific verification has come afterwards. That is to say, he is the genius who promulgates the hypothesis which proves to be the correct one."

"We have to live our lives in practice, and can very rarely wait for scientific verification of our hypotheses. If we did, we should all soon be dead, for complete scientific verification is hardly ever possible. New facts come to light and alter conclusions. It is a regrettable fact that a demand for scientific proof is a weapon often used to delay the development of an idea for the sake of private and very often most unscientific likes and dislikes. We really act on what we believe that matters. Proof can reinforce or weaken belief, but false or incomplete proofs can be both plausible and misleading."

"We in this country are certainly worried about our health: no denial of that is possible. And if it is said, that this worry is hysterical, it may be urged that hysteria is a sub-normal and therefore unhealthy state. We spend £275,000,000 a year on public health services alone and the demand for more expenditure in that direction is increasing." (Compare this statement of Lord Northburn with the statement of Viscount Astor and Seeböhm Rowntree, that "all the vital statistics seem to indicate that disease among human beings, far from increasing is decreasing.")

"The cost of animal disease in 1937 was estimated to be 10% of the total return secured by farmers from their animals. Liability to disease shows itself increasingly among classes of live-stock bred for high production, especially poultry and dairy cows. The mortality in egg-laying trials rose from 6 to 10% in 1929 from 10 to 22% in 1934 in spite of the fact that the greatest care and skill are lavished on the birds concerned."

"Dairy farming is becoming even more trying as a business owing to mastitis, tuberculosis, and breeding difficulties. Yet never before were the animals so "scientifically" cared for. We slaughter many thousands of animals yearly owing to tuberculosis and foot and mouth disease. Yet our ancestors do not seem to have had to bother about tuberculosis in animals, and within living memory foot and mouth disease was a slight incident in the life of most farm animals, often even welcomed by farmers as it was followed by a marked improvement in condition. Certain diseases of sheep in some of the main north country breeding areas are beginning to turn what has been for generations a steady if not very lucrative business, into a highly precarious one. Instances like this could be multiplied."

"In plants we find a similar state of affairs. All sorts of precautionary measures, unheard of previously, seem now-a-days to be necessary if satisfactory crops are to be grown. An enormous annual expenditure is involved in the multiple sprayings which are given to fruit, hops, potatoes, etc., in spite of which these crops are not infrequently overwhelmed or spoilt by disease. Such procedure was quite unknown to former generations, and seems to have been unnecessary.

And it is quite certain that our ancestors often cultivated very intensively. It is equally certain, that there exist a few people who still cultivate intensively with little trouble from disease, without recourse to specific defensive measures against diseases and without artificial manures and without any loss of fertility of the soil."

"Just as we demand for ourselves more and more treatment and more and more hygiene, so we do for our animals and plants. The advance made in the knowledge of the diseases of animals and plants within the last few decades is comparable with that made in human medicine and hygiene. The two cases are in all respects closely parallel. Is it likely that they are both not, in all their aspects, merely aspects of one over-riding phenomenon?"

Although we would like to quote more of this interesting book, we must limit ourselves in this direction. In his last chapter about the "Farmers' Responsibility" Lord Northburn states truthfully that "we habitually look at life in bits and pieces; we analyse and specialise in all departments and are completely bewildered by the complexity of the results. We try to tackle each bit separately; our doing so invariably produces a complication somewhere else. The Hydra grows two heads for each one we cut off."

"In undertaking farming we undertake a responsibility covering the whole life cycle. We can break it or keep it whole. We have broken it, but there is yet time to mend it; perhaps only just time."

"The nature of living things is that they are not mere machines. The fact that from one point of view they are machines has largely deceived us. But they are something more. That something more does not respond to mechanical or statistical treatment. It responds only to that for which we have no other word but love. We have tried to conquer nature by force and by intellect. It now remains for us to try the way of love."

"**The Labouring Earth.**" A Survey of Agricultural Conditions at Home and Abroad by C. Alma Baker, C.B.E., with an Introduction by Rt. Hon. Lord Addison.

Alma Baker is a well known personality. He owns big estates in Malaya and has written many books about agricultural problems like Rubber Planting, or "Facts relating to new scientific discoveries concerning Life-giving foods (1923) or the "Rough Guide to New Zealand's big Game Fishing" (1937). But he was also keen on the development of aircraft and we find a publication with the title "Carry on" (the future service of aircraft). Addition to Battleplane Souvenir (1920). It will perhaps be remembered that a very short time ago the papers wrote about a generous gift from Alma Baker to give a "Spitfire" to the Empire every three months. This personality had an immense interest in agriculture and in the last years of his rich life he came into contact with Rudolf Steiner's methods as outlined in this book. Immediately he started to try these new methods on his estates in Malaya and whenever he came to England he never failed to visit English representatives of these new farming methods to get new

information and to talk over his special farming problems. We had the pleasure of his personal acquaintance, when he visited the Biological Institute at that time in Bray near Maidenhead, and later on Dr. Kolisko was interviewed by Alma Baker concerning his special interest "sheep disease."

In 1938 he published a pamphlet "The Soil and its Products" with the dedication: "In the twilight of a long and full life, I dedicate to the Empire and to Mankind, this Memorandum "The Soil and its Products"—the impressions covering many years of personal experiments in soil problems in outlying parts of the Empire." In the preface of this pamphlet he tells us, that he has dealt with the land and its products for nearly half a century and has vainly tried throughout the years to discover, amongst the numerous manuring and fertilizing substances advocated from time to time, even one wholly satisfactory form or system that would enable disease-free plant and animal life to be produced, and maintained. "Unfortunately none of my former endeavours gave the desired results, but subsequently two rays of light illuminated some of the hitherto obscure causes of soil infertility, and also possibly, the incubator of our many diseases, ill-health, and ailments, continuously hampering the social, political and economical development of mankind."

"The two systems of agriculture that gave me hope of improving the health of soil, plant and animal, and man, came before the public a few years ago, in the methods of "Dynamic Agriculture" and the "Indore Process." "

"Both systems aim at a living soil, but in the Indore Process its originator makes no direct claim to enlist the vital interplay of the unseen influences and forces surrounding all life on earth; while the originator of "Dynamic Agriculture" definitely contends, that the conscious enlistment of such influences and forces by practical measures is absolutely essential for the healthy development of all living organisms."

"The study and practice of the principles of the above two systems of agriculture have impelled me to write this memorandum. I therefore have appealed to all Governments to investigate the influences of manurial substances and systems upon fertility of the soil and the nutritional value of its products."

"The World Press to-day is rife with complaints and enquiries regarding the reduced fertility of the land, and the lessening value of its products, and these, from an unbalanced soil are no longer immune from creating disease."

"Our hospitals, Nursing Homes and Mental Institutions provide ample evidence of the daily increase of disease in human life."

"Is the remedy for this dreadful state of affairs to be left to the working farmer whose time is fully occupied with the everlasting unsatisfactory efforts by trial and costly error to produce a paying crop to support himself, his family, and those he employs, with little or no knowledge of the health or disease—spreading qualities of the crops he harvests, or will the Government in whose hands are the care of the soil, and the health of its people, fully honour the great trust of which they are custodians?"

In the Appendix of this pamphlet Alma Baker speaks of Dr. Rudolf Steiner's System of "Dynamic Agriculture" so that he emphasizes, that of the systems of agriculture he is acquainted with, he considers Rudolf Steiner's method complies more with Nature's requirements for the production of food adequate to human and animal needs than any other system now practised.

In this system the substances of the "Earth's soils are combined with the cosmic influences, while the latter are apparently disregarded by other modern agricultural systems."

"As far as I can judge, "Dynamic Agriculture" is the only comprehensive new system of farming developed in modern times which makes use of old and well-proved principles coupled with new, but obviously reasonable conceptions and theories regarding the ever-present and ever-working quota of natural life in the four Kingdoms of Nature, and thus carries the prolongation of natural plant life into the future."

"Rudolf Steiner lifts the problem of manuring from the level of adjusting the substantial requirements of the plants, to the level of life, by defining manure as "making the soil alive." In doing so, the farmer brings the soil into "good heart," and therefore definite heart-like functions can be said to be promoted in the plant. Thus the plants are enabled to make use of all the beneficial forces and rhythms circulating in their environment. It is the duty of all farmers to establish the right equilibrium between earthly and cosmic substances and forces. In doing so he raises his farm to the level of an individuality."

"At the present time I am following out the practices of this system of agriculture on portions of my rubber estates in Malaya and on my sheep and cattle pastures, crops and orchards in New Zealand and at the same time I am experimenting with other organic substances, in order to compare their effect upon soil conditions, plant growth, and stock nutrition."

Regarding Sir Albert Howard's "Indore" Process for providing Humus, Alma Baker has not "gone into the details of the immensely valuable work inaugurated by Sir Albert Howard in his "Indore" System of Agriculture in India and elsewhere, because in so far as the application of living humus from compost material to impoverished soils is concerned, they are similar in some respects to those advocated by Rudolf Steiner, both as regards the forming of compost heaps and aversion to the application of mineral fertilizers to the soil. Rudolf Steiner however goes much further in his teachings on agriculture as to the definite requirements of plants and animals."

50,000 copies of this pamphlet were printed: they were not for sale, but were distributed to all those who were interested in the content.

In July, 1939, Alma Baker published a new treatise "Peace with the Soil," including an extract from a letter from the Rt. Hon. Col. Sir R. H. Dorman Smith, M.P., then Minister of Agriculture, to Mr. C. Alma Baker: 31st August, 1938, "I have read this paper with the greatest possible interest and do realise that it is a document of first class importance."

"Those of us who are interested in the question of the land and its influence on our national life will be very grateful to you for the work you have done."

This second pamphlet contains the following dedication :

"this treatise "Peace with the Soil" is an amplification of views expressed in my earlier work "The soil and its products"; it is recommended that the two be read together."

"In the twilight of a long and full life devoted to experiments in soil problems in outlying parts of the Empire, I have written two works entirely from a sense of duty to my fellow-men. They constitute an appeal for the re-establishment of

Health in the Soil

Health in Plants and Animals

Health in Man."

This pamphlet also was not for sale, but anyone interested in it was at liberty to copy or use it in any way thought fit, provided such copies or extracts were distributed free of charge.

Alma Baker's last publication is the above-mentioned comprehensive book "Labouring Earth." Lord Addison calls this book in his introduction a "challenging book." It contains an enormous amount of interesting detail and we can only recommend the study of this book to all those who are interested in agricultural problems. We can only quote a few passages.

Chapter I, page 23 : "I set out my views for critical consideration: if they are sound I shall have helped my fellow-men to live more healthily and consequently more happily. My plan is to consider what has happened to the earth, mother of us all, since production was speeded up as a national policy for all nations. My plan is to consider what has happened to mankind while the earth has been exploited and thrown out of balanced cultivation. Finally I hope to produce some reasonable theories of saner methods that may yet enable us to win back what we have lost through a period in which we surrendered to greed and haste and endeavoured unwisely to force the pace of Nature for purely commercial ends. At least I can claim, that I am no armchair investigator. I have been the servant of the soil for more years than I care to count, and have learnt through the results achieved that Nature can be conquered only by obedience to her decrees."

In Chapter II, on National Health, Alma Baker quotes some figures in connection with sickness and curative treatment in Great Britain, which all run into millions of pounds (such as the cost of treatment and maintainance of the sick : £185,000,000) ; but the total outlay on Medical Research is only £200,000 a year.

Page 27. "I am concerned with the question of health of the people and the production of sound crops from healthy soil, but I must turn aside to note the statement in the report that £3,000,000 per annum is the sum alleged to be spent in newspaper advertising of patent medicines and "health foods." The British Medical Association has published some valuable books on patent

medicines, setting out the claims made for them, an analysis of their contents, and a statement of their cost. If these revelations will not stir authority or rouse a credulous public to respect its internal organs, surely nothing can. The Select Committee on Patent Medicines reported twenty-five years ago :

“ For all practical purposes British law is powerless to prevent any person from producing any drug and making any mixture whether potent or without any therapeutical activity whatever (so long as it does not contain a scheduled poison) and advertising it in any decent terms as a cure for any disease or ailment, recommending it by bogus testimonials and the invented opinions and facsimile signatures of fictitious physicians and selling it under any name he chooses, on the payment of a small stamp duty, for any price a credulous public will pay.”

Page 30. “ Turning to nutrition, the report remarks that satisfying appetite is not enough. People may do this and still suffer from malnutrition if they are eating the wrong food, *i.e.*, that which lacks important protective elements. It is a thousand pities, that the statement halts here, after coming so near to the goal. If it had gone on to say that Nature supplies the right food so long as the soil is not defiled and tampered with, and so long as the food is not improperly handled between the fields and the table, the whole problem would have been set out. Then the conscience as well as the common sense of the community would have been helped to function. The Association was in sight of the goal, but those who speak for it forgot to observe that you cannot cure malnutrition with denatured food.”

Page 31. “ The report comments adversely on those large-scale advertisements in papers that direct the public to eat foods for which the advertisers advance extravagant claims. They lay great stress upon the value of milk as an aid to the under-nourished, but I would like to put this question to them. Is it not only possible, but very likely, that the saving grace of the milk will be lost, or at least greatly reduced, on over-mineralized pastures? Can anybody deny that there are far more sick cows than there used to be? As I have pointed out, replacement in New Zealand is over 30% annually, and such complaints as mastitis and tuberculosis are greatly on the increase. To hear experts talk about cows and tuberculin tests suggests that the trouble is far more serious than the man in the street, or rather the woman in the house, has learned to realize. I have been told on good authority that certain butchers in the West of England were complaining more than a couple of years ago that the offals of animals from highly mineralized pastures would not keep. There is something terribly significant about this.”

Page 37. “ I want to insist that the gradual depletion of the earth's fertility is quite a new outrage, if we think in terms of the earth's age; relatively as new as the bombing of undefended cities from the air, and the destruction of merchant vessels by assassins travelling under the sea. In the history of our world the destruction of the soil and the destruction of civilization as constituted in our

time are both affairs of yesterday; even "villanous saltpetre" is not old in relation to the world it has injured. It was only a hundred years ago—since 1840 to be precise—that the chemist began his terrible invasion of the soil. Whatever the colour, the creed or nationality of the agriculturist, he is well aware that down to a few years ago the living fertility of the soil has been fostered and maintained by nature's own methods; residues of plants and animal life had gone through such necessary process as nature has ordained. Her procedure in the outward aspect visible to the simplest among us, is plain enough—a revival of the living organism through marvellous residues known to mankind as humus, but not yet completely understood; it is the material to which the earthworms and micro-organisms lend the aid without which life could not endure, the material through which mysterious symbiotic development takes place. In a welcome article "The world beyond the Eye in Agriculture," Dr. W. J. Stein reviewing certain works (including Dr. Wakesman's great volume on humus) emphasized the author's contention that humus is rather a certain state of matter than a mere affair of chemical constituents, and that the problem of humus and soil belongs to the domain of biology. As I see it, humus helps by the aid of soil micro-organisms to maintain a certain harmony between man, animal and soil. It is a mystery, this ever active force that maintains fertility on the few inches of earth from which humanity and the animal and vegetable creation draw breath. We must approach it with reverence and not think of it as something that we can control by the aid of crude chemicals."

Page 39. "I have come to the conclusion after many years of closest study, that the addition of man-made dead materials such as chemical "fertilizers" to the soil not only checks life but affects adversely the life in the atmosphere around it which is essential to the growth of the plant until its life is ended."

Mr. Alma Baker speaks about the League of Nation's report on page 46: "I seemed to get to my own particular line of country when I read in the report that the United States of America in ten years raised its tractors from less than a quarter of a million to upwards of 800,000 between 1920 and 1930, and that in the same time the number of horses fell from 17,000,000 to 13,000,000. In 1918 14 combine harvesters were at work in Kansas. (As most people know these are machines by which two men can harvest 50 acres of wheat a day). Eleven years later there were 23,000 combine harvesters in Kansas and to-day Kansas is in the Dust Bowl. Here we see the cause and the effect if you can harvest 50 acres a day with two men, you do it over as wide an area as possible and if you can do it in one year, why not do it again in the next? Then the cheapest way of dealing with the land is to run the tractor ploughs over it and make a bare fallow. It all sounds so easy until Nature intervenes and sends her dust storms to blow your surface soil into the ocean, a thing no dust storm could have done had you been practising mixed farming and followed your corn with a green crop."

Page 94. "Now, agricultural scientists we have enough and to spare, while they continue along their present narrow lines of investigations, but there is an

enormous piece of work before them if they will only expand their outlook and undertake to meet the need of the hour. I would like to set out the task I regard as vital :--

1. They should do something to understand and to explain to simple farm folk the parts played in food production by the earth and the cosmos, the difference between the forces and substances and the effect of both upon plant life and growth. At present most of us know much or little about substances, and little or nothing about forces.
2. They should enquire into the ascertained effect of administering plant stimulants in the form of artificial manures and the possible or probable results of continuing along this dangerous road.
3. They should study the best method of agriculture and the best use of organic substances to replace dead synthetic manures, restore lost fertility to the soil and enable the farmer to produce natural healthy food plants for man and beasts and a reasonable profit to himself. They should inquire into the value of composts and the extent to which these can be made available.
4. They should inquire into the value or lack of all advertised plant stimulants and advise the public. They must reach the simple farmer and tell him in a fashion that he can understand, something of the danger of the methods that have been practised of late years. I suggest that the only way in which the work to be done can be followed out is along the lines of abandoning the materialistic aspects, recognising the land as something that is living its own life, fulfilling its own part in a divinely ordained programme and insisting in its own silent fashion upon the observance of many laws of which at the present stage of our evolution we know little. I want them to take as their goal the development of national health through the production of healthy food. It is for them to bring the cosmos home to the farmer and their task will be lightened if they will undertake it with real determination guided by the fact that there is a traditional husbandry that has never been lost. When the world was young, farmers were in touch with Nature and they can recover the lost touch if they are set upon the right lines."

Page 107. "The case for mineral fertilizers can be put in a nutshell. We are told that there is not enough organic manure to go round the farms. This being said, no further case remains. I would like to approach this problem by suggesting that it is possible for a remedy to be worse than the disease ; it is also readily possible for the remedy to be ineffective for more than a very little while and to leave the patient worse than it found him."

Page 108. "Modern fruit culture has resulted in an increase of troubles due to poisoning by lead, arsenic and copper, all of which are used in sprays. A study of Californian apples made a few years ago showed that the lead arsenate in them

was very many times as much as the highest quantity that can be safely taken in food. Public warnings were issued. There is a very vicious circle here. Poison sprays are used because insect pests are on the increase, and we get the insect pests because they are Nature's challenge to the man who, in search of larger and heavier crops, throws her balances out of gear. Doubtless many who have not investigated this question will cry : " Nonsense " ; informed people will not. This reaction to artificial stimulants seems strange, even unreasonable, until we grasp a fact that has been established by Dr. Steiner and confirmed by his followers, that if we change the life of a plant by over-stimulation the whole of the life-force is spent on a greater production and there comes side by side with this a certain weakening of the powers of healthy reproduction and of resistance to insect pests. A healthy plant in a healthy environment grows away from disease and is powerful to resist insect attacks ; a weak plant falls a victim, and then come the poison sprays, in ever increasing quantity, to kill the insects and perhaps to poison the produce. Certainly there is grave reason to believe that the nutritional value of the plant is upset."

Page 156. " Here is a simple problem of putting first things first . Of what use is it for the Governments to plan increased productions, for agricultural engineers to devise bigger and better machinery, for service on the land to be made more attractive, for subsidies given for wheat and sugar beet, for Boards to be established for milk, pigs, and the rest, if the quality of these products is to be vitiated by a sick soil which we continue to poison or to neglect. I would like to see a quiet but speedy awakening to the needs and the rights of the land, but I am convinced that an awakening of some kind is coming soon, and I pray it may not be too violent. The man who betrays his country is denounced as a traitor ; the man who betrays every man's country, Mother Earth, is subjected to no penalties. Qualified engineers can tell within a very few years the life of a mine ; they know it can yield so much and no more. Why has nobody applied the same kind of calculation to the earth and explained to the general public that every virgin soil has so much stored fertility and no more, and that if it is taken without replacement that soil must die ? "

One chapter of the book is dedicated to the teachings of Dr. Steiner and Alma Baker ends this chapter in the following way : (page 208) " It is a curious and encouraging truth that in spite of his strange theories his complete conviction and his indifference to criticism, ridicule, distortion and mis-statement, Rudolf Steiner's teachings have not only survived him, but are slowly but surely building up an enduring monument to his life and work. When a man eminent in many spheres can say of himself people will remark ' what a pity he has gone suddenly crazy ! ' or ' all this will seem utterly mad,' we can but recognize a fine, rare courage, for ridicule is among the hardest burdens that a sensitive pioneer can be called upon to bear. No mere research worker of ordinary calibre, Rudolf Steiner was sustained by a faith that was as the shadow of a great rock in a thirsty land ; in spite of the hatred and opposition that came to him from all centres of

reaction he persisted to the end, and to-day his posthumus reward grows." "Let us praise famous men."

Another extremely interesting chapter is the one dedicated to Sir Albert Howard, formerly Director of the Institute of Plant Industry at Indore in India and founder of the method of soil regeneration to which he has given the name of "Indore Process."

(Page 223). "His "Indore" process of composting is spreading throughout the East, where it is regarded as a commercially sound proposition. It is being developed more slowly at home, where vested interests have a powerful voice in the decision as to whether man shall live on healthy produce which can be raised from the soil for the soil, or shall die for the greater glorification of business. He has written words over which I like to linger, because they express my strongest innermost conviction: the earth has been exploited for gain-starved, poisoned and over stimulated at one and the same time by artificial manuring, de-timbered, over-grazed, over-stocked and over-cropped. By the time science was called in to undo the results of her own folly so far as was possible, the balance between soil and plant had been rudely disturbed; there was no fertility left to work on."

Page 223. "For my humble opinion Dr. Rudolf Steiner and Sir Albert Howard are two men who have done more for mankind than almost any of their contemporaries. The man who eradicates disease is worth more to mankind than the man who cures it. Steiner, among those who have passed, and Sir Albert Howard, among those who are happily still with us have called attention to the most serious danger threatening mankind and have pointed out the simple effective road to change."

(Page 224). "Sir Albert Howard's method is the outcome of tradition. He is completely honest and admits that he sat at the feet of the Indian ryot and absorbed and accumulated wisdom of the years."

The originator of the "Indore Process"—and it may claim originality even if it be the modern adaptation of an old wisdom—has given forty years to study the health of crops and live-stock and to research into conditions that create disease or help to resist it."

"He comes from a family of farmers and began his research forty years ago in the West Indies, where he studied tropical agriculture. After a short spell at Wye College in Kent, where he was especially concerned with hop diseases, he was appointed Imperial Economic Botanist to the Government of India at Pusa, where he was left with a free hand to make his own experiments. He says that his best teachers were the Indian peasants themselves and in a few years he had learned how to grow healthy crops without any of what he has described as the "expensive paraphernalia of the modern experimental station." He made some astonishing discoveries which are borne out by the researches of Dr. Steiner, who was working to the same goal along his own lines, each man seeing the truth through windows of different coloured glass."

"He found that insects and fungi are not the real cause of plant diseases but are rather effects of unsuitable varieties of improper acts of husbandry. He concluded that the policy of poison spraying, so appallingly popular in this country to-day, is unscientific and unsound and that we ought to be concerned with growing healthy crops that would not stand in need of these abominable aids to life. Then he turned to the diseases of cattle and discovered that well-chosen and well fed animals are insusceptible to the prevalent diseases, including foot and mouth disease and rinderpest. The time came when he could place his own healthy animals among diseased ones and nothing happened."

(Page 226). "Sir Albert Howard told the story of his life experiments at the meeting held in the Town Hall of Crewe in March, 1939, to which reference has already been made elsewhere. He and Sir Robert McCarrison were the chief speakers, and he wound up his address by saying that humus feeds a plant by providing indirectly the small quantities of nutrient needed by the green leaf for growth, while artificials only supply salts for the leaf and are consequently unable to influence quality. He went on to state what many connoisseurs have noted, without being able to give the reasons, that meat and cheese from some of the celebrated pastures of Europe have lost both taste and quality, and he attributed the loss to the use of sulphate of ammonia which, unfortunately, is still recommended by the authorities."

"Sir Robert McCarrison is the authority who told us about the vigorous and healthy races of North India who live on freshly ground whole wheat flour, milk pulses, fresh vegetables and occasional small quantities of meat. He says that food is the dominant factor in determining man's physical endowment, powers of endurance and resistance to diseases. He tells us that the human stomach is designed to digest all sorts of natural food but when we present it with sloppy, disintegrated, highly sweetened and easily digested food, it is relieved of half its work and consequently becomes functionally inefficient."

(Page 227). "Proofs of the deterioration that follows the use of artificial fertilizers have been forthcoming and are still forthcoming from many quarters, but a significant English example comes from Lord Lymington's estates in Hampshire, where wheat straw taken from fields manured with organic matter serves ten years as roof thatch while straw from similar land manured with artificials lasts only half the time."

The last chapters of Alma Baker's book are dedicated to proposals when peace returns, and plans for the future.

These are a few examples to illustrate the present situation. We have not even the excuse that people do not know about the critical state of affairs in Agriculture. You can read it in many books written by famous personalities and side by side you have the advertisements for artificial manure and poison sprays: demands for speeding up plant growth, for getting more and more in less time,

and with less natural means. It is "Science" which asks you to do the one thing, and it is "common sense" which asks you to do the other things. There is even "Science fighting against Science."

We are at war not only with the outside world, there is another war going on within our life and this war we will also have to fight to the bitter end.

Chapter II.

Our Tasks for Tomorrow.

The agricultural Problem is a World Problem. It has to deal with the welfare of Mankind. It is not a question of personal likes or dislikes, or even national interests. What would be the use if only one country were able to produce healthy crops and neighbours could not do the same? Our outlook must become world-wide, our knowledge universal, and our love and understanding for humanity all-embracing.

The immense task we see before us seems to consist of **three** main parts :

Agriculture

Medicine

Education.

These three : Agriculture, Medicine and Education should not only stand side by side, helping each other, but in reality should melt into one another, becoming a living entity : "**World Agriculture.**"

The food the farmers grow is meant to build up man's physical body, and to give him strength to develop his mental capacities. It is a question of health, and therefore a thorough medical knowledge must stand side by side with all the measures agriculture wants to introduce in food production. But again we must say - not our present medical knowledge ; it must be a medicine based on a true understanding of Man : a medical knowledge which can look on the human being in its threefoldness of body, soul and spirit. A medicine which only treats the human body and forgets that in this body is incarnated a soul and a spiritual being, is insufficient. It is as harmful to the human body as an agricultural science which only looks at the chemical constituents of the soil and forgets the Life—is to the earth. Such a science feeds the living plant with dead salts, and ignores all the cosmic forces streaming through a balanced soil, so that at last it even takes away the soil altogether, and offers only a salt solution with artificial support to the growing plant !

We need a medical science which can understand the three-fold human organism as expressed in his nervous system, circulatory and breathing system, and metabolic system. A science which looks on Man as a combustion engine which burns food, as the motor car uses petrol, is not only useless, it is a dangerous science. It causes us to lose our dignity as Man.

The medical science we have in mind, must also have a universal outlook, and be able to look upon Man as standing on Earth and reaching to the Heavens, the whole Cosmos reflected in his head, the Sun's forces circulating in his heart, and the Earth power strengthening his limbs and streaming through his metabolic system.

Thus we visualize a "World Agricultural Movement," comprising in itself three main sections with their specific tasks.

The specific tasks of the **Agricultural Section** in this World Agricultural Movement would consist of :

1. Practical advice to Farmers and Gardeners all over the world, to help in their special problems of cultivating the soil and its products, and the rearing of live-stock.
2. Research. Much research work is still to be done. Rudolf Steiner's suggestions were meant for our countries. They must be altered accordingly if we move to the Far East or to the Far West. The co-operation of many scientists in different parts of the world is necessary.
3. Education. We need the training of agricultural teachers: men and women thoroughly trained in practical work and in science.

Of course here we can only outline a very rough sketch. Each of these three items should be elaborated in many details.

The specific task of the **Agricultural—Medical Section** would be :

1. Practical advice in all the problems of Nourishment and Diet ;
2. Public Health;
3. The cultivation of medicinal herbs ;
4. Veterinary medicine, etc.

The specific tasks of the **Agricultural—Educational Section** would be :

1. To convey the right ideas about food, nourishment and plant cultivation to children even in the elementary schools.
2. To educate the public. This is a very important task. At present the public is educated by grocers, chemists, druggists and health-stores. They gain their knowledge mostly by reading the different recipes on the food packages they buy, or on the fertilizer packages, or by seeing advertisements which catch the eye. The education of the public could be done through literature, by books which are easy for everybody to understand and through lectures.

What is needed in order that such a scheme should come to life ? **Money and suitable collaborators.** Of course much money is necessary and the collaboration of many people all over the world. Do not say that there is not enough money available. If you have studied the content of this book, you will have found out that millions of pounds are lost each year through animal diseases, millions are spent for advertising artificial fertilizers, etc. Why should there not be somewhere some millions for a good purpose, for mankind's sake ?

But all the money of the world would not help, if we are not able to kindle in men's souls a burning flame of enthusiasm for this work ; if we cannot make those who wish to collaborate understand that they must bring with them into the work great and unselfish love urging them to do something for mankind.

CONCLUDING NOTE

Much time has elapsed since the completion of the manuscript and the actual finishing of the print: all the long war years from 1940 to 1946. Many obstacles had to be overcome, from the paper restrictions to the shortage of labour, but at last the work is done.

Now I want to thank in the first place, Rudolf Steiner who entrusted me with the beautiful task of making the necessary scientific investigations connected with his advice.

Then I want to thank all those who helped me with the actual work carried out in the "Biologisches Institut am Goetheanum" in Stuttgart (Württemberg), and, later, in the "Biological Institute" Bray, Berks. In the first place Mr. W. Kaiser must be mentioned; he worked faithfully for many years until the beginning of the war, placing his skill as a mechanic at my disposal, working hard in the garden or in the dark room, making most of the beautiful photographs contained in this publication and in my previous ones; and digging the hole for the experiments beneath the surface of the soil. He worked ceaselessly, if necessary day and night. Then I have to mention Mrs. L. Deman, who helped with experiments connected with "smallest entities," Mrs. Lilian Schickler, who specially helped with weighing and feeding the white mice, and Miss J. Beck, who assisted with the experiments carried out beneath the surface of the soil.

Furthermore, I want to express my deepest gratitude to the many friends who helped, and are still helping financially, so that the work can be done. From all parts of the world help has come: from America, England, Germany, Holland, Portugal and Switzerland.

In writing this book I was helped by Mrs. E. C. Merry and Miss Gladys Knapp who read the manuscript. Miss Knapp also drew the graphs and sketches, as well as the title page and read the proofs. I want to express my sincerest gratitude for her kindness and understanding.

But all this would not have been enough, if more friends had not come to my aid, contributing generously towards the printing of this book. Many have helped, and I cannot mention them all; they would not even like it. But I want to say: "Thank you for selfless contributions to a good cause, for mankind's sake."

Most of the blocks in this book were made by the Gloucester and Three Counties Photo Engraving Company. I would like to thank them for making these as quickly and beautifully as possible under the present difficult circumstances.

I also want to thank Mr. Jennings and his staff for devoting so much care to the printing of the book. I appreciate their warm interest and willingness to co-operate, which made it possible to overcome the various difficulties arising from war-time conditions.

As far as the contents of this book is concerned, I tried to carry out each experiment as conscientiously as possible; to repeat it again and again until I was certain of the result. Maybe some readers will find, that I have expressed my convictions with too great a frankness, that I have not always been polite enough. But the times are so serious in which we are living, that if we want to make any impression at all, we have to speak in strong terms. Re-reading the manuscript for the last time, I hesitated for a moment at the sentence: "Let us become true scientists and lift up the priceless jewel which has fallen into the dust." I could hear the critics cry: "What an outrage to science!" It is not meant as an outrage, and I cannot take out this sentence. The case is the same with many other sentences. I do not overlook or under-rate the high technical and intellectual standard natural science has achieved. Only to where does this science lead us? It is a perfect, pure, objective, impersonal science. Its latest and "greatest" achievement has been the release of atomic power: the atom bomb. One invention gives birth to another. The one scientist invents the atom bomb; the other has to invent the anti-atom bomb to protect mankind against the terrible weapon just invented. A whole Anti-Atom-Fleet is being planned, so we read in to-day's Daily Mail (1st January). "Revolutionary plans for Britain's new Anti-Atom-Fleet will be made in a report to be delivered next March by a special committee to be appointed by the Admiralty Commissioners." We can be certain, that after the Anti-Atom-Fleet has been created, another scientist will invent a Super-Atom-Bomb, against which terrific destroying power, the Anti-Atom-Fleet will again be too weak; never mind, there will again come another scientist to plan a Super-Anti-Atom-Fleet.

What can be done to wake up Mankind? This science is of a purely destructive character. It is pure intellect, without a heart beating for mankind. It is a priceless jewel fallen into the dust. Scientists have to make the first step to redeem it again, to create a new **"Science of Life" which places Man in the centre, which looks at everything from the standpoint of Man, and not from the standpoint of Science.** Man has to be understood as a spiritual being. He has not only a brain, intellect, he has a soul and spirit. Present day science is purely intellectual. Thoughts are produced and seem to run on automatically. We are living in illusions, in a world of make believe. We are asked to accept as food, things which look like, or taste like, or smell like real food, but simply are not. A cordial which is "orange-flavoured" or "lemon-flavoured," or grape-fruit-flavoured" does not give us the forces of these fruits. We cheat ourselves with open eyes (or are they open?). Why produce false sensations? And who is doing all this cheating? Science, who offers so, us generously, all these substitutes. We cannot be offered a substitute for life. Let us fill this "pure" science with a soul and turn it round from the downward road into material destruction, to the path which leads upwards to spiritual perfection. Matter and spirit are not opposed if we recognise that matter is permeated with spirit.

Do not let us release the atomic power. Do not let us set loose upon mankind the evil destructive forces—but let us strive for the good and constructive power

hidden in matter. Otherwise, we will find out too late that we have created a boomerang which recoils towards us, destroying everything. Let us release gently the forces behind matter, in potentizing substances and thus bringing to life the healing, remedial effects, but not in an explosive, destructive manner. In 1923 I published the first experiments carried out with "smallest entities,"* following advice Rudolf Steiner had given me in 1921. And here in England Rudolf Steiner lectured at Penmaenmawr about "The Evolution of the World and of Humanity." He mentioned during these lectures, the publication of these researches carried out in the Biologisches Institut am Goetheanum (Stuttgart), and I would like to quote a few sentences spoken then by Rudolf Steiner: "Along these lines we have succeeded in dividing what is merely material, so that what is really the Spiritual part becomes apparent. For if you do not simply split matter into atoms as the atomists do, but reduce it to its functions and forces, you prove your goodwill, as I might say, to pass through the Material itself, into the Spiritual." After describing these researches more in detail Dr. Steiner continued: "In future, if this result of research is valued aright, investigations will not merely be made along the lines of scale and measure, the laws of nature will not merely be investigated atomically, but it will be recognised that in all matter a rhythm can be discovered, and that the rhythm in the occurrences of nature reproduce the rhythm of the cosmos."

Science has progressed further from 1923 to 1946. We do not only split matter into atoms, we can even split the atoms themselves, and have in our hands a most powerful tool for destruction.

We can look at matter as being in a neutral state. Man can use it in two ways—either for good or for evil. We can release the forces behind matter gently by "potentizing," or in an explosive way by splitting its atoms. Scientists want now to find some better uses for atomic power, and are trying to find a way to introduce it into agriculture for stimulating plant growth. This is told to the public in an article: "Science Survey," by Ritchie Calder, in the *Nees Chronicle* of Wednesday, February 27th, with the title, "Fission Farming." The term "fission" means the energetic disintegration of uranium. The above article states that "Fission Farming" where the crops will be radio active, is the latest ingenious project of the atom splitters. The idea is really ingenious. Radio active elements—carbon, phosphorus, nitrogen and so on which are given the temporary characteristics of radium, will be fed to plants. Since these elements are radio active they can be traced, and the scientists hope to solve by this means the riddle of photosynthesis, "the device by which plants trap and use the sun's energy." They hope to solve the riddle of "chlorophyll," or how the plants collect carbon. So far so good. But these radio active substances are hoped to provide clues to many other "processes in plants and in human bodies" and last, but not least, they are to be used in treatment too. "Radio active iodine, when administered, rushes to the thyroid, and, if active enough, can arrest the abnormal

* L. Kolisko: *Physiological and Physical Proof of the Efficacy of Smallest Entities*, Stuttgart 1923. (*Physiologischer und Physikalischer Nachweis der Wirksamkeit Kleinster Entitäten*).

growth which sometimes occurs in that gland. Or radio active phosphorus can be used to treat leukemia—sometimes called "the cancer of the blood"—a disorder in which the white blood cells run amok. The radio active phosphorus is carried into the bone-marrow where the cells are being mass produced and acting like localised radium, restricts production to normal. If, from the atomic pile we can get enough radio-phosphorus to control this disease it will be a grim compensation. For leukemia is the disease of which so many, unhurt by the explosion, died later at Hiroshima and Nagasaki. The hard X-rays released by the bomb explosion destroyed the proper functioning of the bone-marrow."

Here is the point where the danger lies. Are we right in introducing radio active forces into human bone-marrow? There is the source of life, where our red blood is generated. Our whole being is linked with the mysteries of blood production. Are we entitled to touch this source of life? Do we already understand what blood is and do we understand what the radio active force is, and can we allow these two elements to work upon each other? It is different if we use radio active elements in a laboratory experiment, as tracer to study various processes in nature—and if we introduce it into the human body. The atomic energy has destroyed many lives through after-effects, as mentioned in the above article. The blood was attacked directly, and now it would be a "grim satisfaction" to heal leukemia with radio-phosphorus. Are we not attempting to drive out the devil with the help of Satan?

Maybe, what is described in the article "Fission Farming" will never come true. Maybe science will abandon, after careful investigations, these dangerous experiments with the human body. But it may as well be, that, in future, diseases will be treated not with ordinary remedies, but with radio active remedies. Mankind will be treated from outside with X-rays, and from inside the various organs will be attacked by radio active remedies. Between all these radiations the human organism must fall into decay. The path seems to go straight on in only one direction—towards the destruction of plant life, animal life and ultimately, human life.

Mr. Winston Churchill quite recently summed up the present world situation when he received the freedom of Aberdeen, saying: "This is a time when hatred is rife in the world, and when many mighty branches of the human family, victors or vanquished, innocent or guilty, are plunged in bewilderment, distress or ruin. The world is very ill. Measureless injury has been done to much that the 19th century would have called Christian civilisation. All the leading nations have been racked by stresses which have blunted their sensibilities, and have destroyed their agreeable modes of social intercourse."

"Only science has rolled forward, whipped by the fierce winds of mortal war, and science has placed in the hands of men agencies of destruction far beyond any development of their common sense or virtue."

But we have to overcome the hatred and turn it into love. Otherwise we are going on to "sow the wind and reap the storm." Let us abandon this destructive path and turn to the source of life. Let us create a new science of life which really understands the inter-action of the whole cosmos with earth and Man.

May, 1946.

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ERRATA.

BLOCKS Fig. 212 on page 270 and Fig. 213 on page 271
have to be exchanged.